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April 1995

DRAFT
Environmental Impact Statement

Expanded Moxa Arch Area Natural Gas Development Project

Sweetwater, Lincoln, and Uinta Counties, Wyoming

The Bureau of Land Management is responsible for the balanced management of the public lands and resources and their various values so that they are considered in a combination that will best serve the needs of the American people. Management is based upon the principles of multiple use and sustained yield; a combination of uses that take into account the long-term needs of future generations for renewable and nonrenewable resources. These resources include recreation, range, timber, minerals, watershed, fish and wildlife, wilderness, natural, scenic, scientific, and cultural values.

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United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Wyoming State Office
P.O. Box 1828
Cheyenne, Wyoming 82003-1828

In Reply Refer To:

1793 (930)
Moxa Arch
(930DHorsey)
PHONE NO: 307-775-6290
FAX NO: 307-775-6082

April 14, 1995

Dear Reviewer:

This draft Environmental Impact Statement (EIS) on the proposed *Expanded Moxa Arch Area Natural Gas Development Project* is submitted for your review and comment. This EIS has been prepared to analyze the potential impacts from additional infill natural gas development proposed by several companies within the existing Moxa Arch Natural Gas Field located in Sweetwater, Lincoln, and Uinta Counties, Wyoming. Four Technical Reports have been prepared in conjunction with the EIS - Air Quality, Wildlife Surveys, Soils and Water Resources and Vegetation/Wetlands/Special Status Plants. These may be reviewed at the BLM offices listed below.

If you wish to comment on the EIS, we request that you make your comments as specific as possible. Comments will be more helpful if they include suggested changes, sources, or methodologies. Comments that contain only opinions or preferences will not receive a formal response; however, they will be considered and included as part of the BLM decisionmaking process.

At this time, no public hearing is scheduled for this EIS. If enough people indicate an interest in having a public hearing, one will be scheduled. If you are interested in attending or presenting material at a hearing, please use the sheet provided for this purpose on the page following this letter. Requests for a hearing must be received by May 19, 1995.

This EIS was prepared pursuant to the National Environmental Policy Act, and other regulations and statutes, to address possible environmental and socio-economic impacts which could result from the project and to solicit public comments and concerns. This EIS is not a decision document. Its purpose is to inform the public of the impacts associated with implementing the companies' infill drilling proposal and to evaluate alternatives to the proposal. This EIS is also intended to provide information to other regulatory agencies for use in their decisionmaking process for other permits required for implementation of the project.

Please retain this copy of the EIS for future reference. A copy of the EIS has been sent to affected Government agencies and to those persons who responded to scoping or otherwise indicated to BLM that they wished to receive a copy of the EIS. Copies of the EIS are available for public inspection at the following locations:

Bureau of Land Management
Wyoming State Office
2515 Warren Avenue
Cheyenne, Wyoming 82001

Bureau of Land Management
Rock Springs District Office
Highway 191 North
Rock Springs, Wyoming 82901

Bureau of Land Management
Kemmerer Resource Area Office
312 Highway 189 North
Kemmerer, Wyoming 83101

Sincerely,

Alan R. Pierson
State Director

There are presently no plans to hold a public hearing on the *Expanded Moxa Arch Area Natural Gas Development Project Draft Environmental Impact Statement* (EIS) because of the apparent lack of unresolved substantial environmental controversy concerning the proposed project.

You are invited to provide written comments on this Draft EIS. We are also encouraging you to visit the local Bureau of Land Management (BLM) offices listed in the Dear Reviewer letter and talk with the Managers about any concerns.

If enough people indicate a desire to testify, a public hearing(s) on the *Expanded Moxa Arch Area Natural Gas Development Project Draft EIS* will be scheduled.

If you would like to testify or attend a hearing, please return this tear-out sheet, fold as indicated on the back, staple or tape, stamp, and mail. It must be received no later than May 19, 1995 in order to be considered. If enough responses have been received to warrant one or more hearings, a hearing(s) will be arranged. Information on the hearing(s) will be published in state and local newspapers, other media sources, and direct mailing to the recipients of the Draft EIS to give the public enough notice.

Yes, I am interested in testifying at a public hearing. I would prefer the hearing to be held in:

___Rock Springs, Wyoming ___Green River, Wyoming ___Kemmerer, Wyoming

Name:______________________________

Mailing address:______________________________

____

Telephone Number: ( )______________________________

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Stamp

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TO:
Bureau of Land Management
Expanded Moxa Arch Natural Gas EIS
Bill McMahan, Project Coordinator
P.O. Box 1869
Rock Springs, WY 82902-1869

EXPANDED MOXA ARCH AREA NATURAL GAS DEVELOPMENT PROJECT

Sweetwater, Lincoln, and Uinta Counties, Wyoming

ENVIRONMENTAL IMPACT STATEMENT

[X] Draft [ ] Final

Lead Agency:

U.S. Department of the Interior, Bureau of Land Management

Cooperating Agencies:

U.S. Department of the Interior, Bureau of Reclamation

Counties That Could Be Directly Affected:

Sweetwater, Lincoln, and Uinta Counties, Wyoming

Abstract:

The Draft EIS analyzes a proposal by the Moxa Arch operators to continue to drill additional development wells in their leased acreage within the Moxa Arch oil and gas development area of southwestern Wyoming. The Moxa Arch operators include Amoco Production Company, Union Pacific Resources Company, Wexpro/Celsius Energy Company, Bannon Energy, Marathon Oil Company, Presidio Exploration, and other companies (collectively referred to as the Moxa Operators). Lands associated with the additional drilling program include those previously analyzed in the Amoco Production Company Moxa Arch Natural Gas Production Environmental Assessment (EA) and Decision Record (DR) (United States Department of the Interior, BLM 1991) and the Supplemental EA and DR to the Amoco Production Company Moxa Arch Natural Gas Production Project (United States Department of the Interior, BLM 1992). Additional areas analyzed in the EIS include lands north and south of the area analyzed in the previous EAs. The additional area combined with the lands analyzed in the previous two environmental analysis documents form the Expanded Moxa Arch Natural Gas Development (Moxa) analysis area (approximately 476,261 acres).

The Moxa analysis area includes portions of western Sweetwater, southwestern Lincoln, and northeastern Uinta Counties, Wyoming. The project area is generally located within Townships 15 through 23 North, Ranges 111 through 113 West, 6th Principal Meridian. The area is accessed by Interstate 80 and U.S. Highway 30. Access to the interior of the Moxa analysis area is provided by an extensive road network developed to service prior and on-going drilling and production activities. The Moxa Arch Field is located in an area of checkerboard land ownership with approximately 55 percent Federal, 42 percent private, and 3 percent State. An extensive infrastructure of roads and pipelines for natural gas production is already in place within the Moxa Arch Development Area.

Over the next 10 years, the Moxa Operators propose to drill up to 1,325 additional infill wells, where 957 wells are presently active, to allow for the maximum recovery of natural gas from existing Federal, State, and private oil and gas leases. Additional roads and pipelines would be necessary to link the wells with existing transportation pipelines. Drilling estimates were based on the Moxa operators reasonable expectations that the "tight-gas" formation in this area could be developed at a average level of four wells per section within the "proven" production area and up to two wells per section within the "flank" area. A portion of the project area is presently developed on a 160-acre spacing (four wells per 640 acres). The Moxa Operators' plans and drilling schedules would be contingent upon both an increased demand for natural gas supplies in response to the Clean Air Act amendments of 1990 and an adequate price for the gas at the wellhead. The Draft EIS describes the physical, biological, cultural, historic, and socioeconomic resources in and surrounding the project area. The focus for impact analysis was based upon resource issues and concerns identified during public scoping. Potential impacts

of concern from development were to livestock forage; recreation associated with Fontenelle Reservoir; crucial big game winter range and antelope migrations; sage grouse and raptor breeding and nesting; special status plant and wildlife species; soil erosion and sediment increases to the Hams Fork, Blacks Fork, and Green Rivers; groundwater contamination; Oregon, Mormon Pioneer, Pony Express, and California Historic Trails condition and viewshed; and cumulative effects.

Other Environmental Review or Consultation Requirements:

This draft EIS, in compliance with Section 7(c) of the Endangered Species Act (as amended), includes the Biological Assessment for the purpose of identifying any endangered or threatened species which are likely to be affected by the proposed action.

Lead Agency Contact:

For further information, contact Bill McMahan at the Rock Springs District Office, (307) 382-5350.

Comments on this draft EIS should be submitted in writing to:

Bureau of Land Management
Bill McMahan, Project Coordinator
P.O. Box 1869
Rock Springs, Wyoming 82902-1869

Date EIS Made Available to EPA and Public:	Date By Which Comments Must Be Received:
April 21, 1995	June 12, 1995

DEPARTMENT OF THE INTERIOR

DRAFT
ENVIRONMENTAL IMPACT STATEMENT

on the

EXPANDED MOXA ARCH AREA NATURAL GAS DEVELOPMENT PROJECT

Sweetwater, Lincoln, and Uinta Counties, Wyoming

April 1995

Prepared By:

This Environmental Impact Statement was prepared by *Holsan Environmental Planning* environmental consulting firms, with the guidance, participation, and independent evaluation of the Bureau of Land Management (BLM). The BLM, in accordance with Federal Regulation 40 CFR 1506.5(a) & (b), is in agreement with the findings of the analysis and approves and takes responsibility for the scope and content of this document.

Wyoming State Director

ABBREVIATIONS/ACRONYMS

ABBREVIATIONS

AADT	annual average daily traffic
AASHTO	American Association State Highway Transportation Officials
ac-ft	acre-feet
ACHP	Advisory Council on Historic Preservation
ADT	average daily traffic
AO	authorized officer
ANC	acid neutralizing capacity
APD	application for permit to drill
AQD	Air Quality Division
AQRV	air quality-related values
ASTM	American Society of Testing Materials
AS-WWC	Archaeological Services of Western Wyoming College
AUM	animal unit month
BA	biological assessment
bbls	barrels
BCF	billion cubic feet
BCPD	barrels of condensate per day
B.P.	before present
BLM	USDI Bureau of Land Management
BMP	best management practices
BO	barrels of oil
BOE	barrels of oil equivalent
BOD	biochemical oxygen demand
BOP	blowout preventer
BWPD	barrel weight per day
CAP	Big Piney/LaBarge Coordinated Activity Plan
cc	cubic centimeters
CEQ	Council on Environmental Quality
cfs	cubic feet per second
CIA	cumulative impacts analysis
Cl	chloride
CMP	corrugated metal pipe
CO	carbon monoxide
CO_2	carbon dioxide
COE	U.S. Army Corps of Engineers
CP	cathodic protection
cu.ft/day	cubic feet per day
CWA	Clean Water Act
dBA	decibel
DEQ	Department of Environmental Quality
DR	Decision Record
EA	environmental assessment
EIS	environmental impact statement
EMT	Emergency Medical Technician
EO	Executive Order
EPA	Environmental Protection Agency
ERRP	Erosion Control, Revegetation, and Restoration Plan
°F	degrees Fahrenheit
FEMA	Federal Emergency Management Act
FHWA	Federal Highway Administration
FONSI	finding of no significant impact
FS	USDA Forest Service
FWS	U.S. Fish and Wildlife Service
FY	fiscal year
GIS	Geographic Information System
gpm	gallons per minute
H_2S	hydrogen sulfide
HWA	Hayden-Wing Associates
I-80	Interstate Highway 80
IDT	Interdisciplinary team
KOP	kick-off point
KRA	Kemmerer Resource Area
KSLA	Known Sodium Leasing Area
mg/l	milligrams per liter
MAEA	Moxa Arch Environmental Assessment
MAEIS	Moxa Arch Environmental Impact Statement
MBC	thousand barrels of condensate
MBO	thousand barrels of oil
MCFG	thousand cubic feet of gas at one atmosphere pressure
µg/l	micrograms per liter
MMBO	million barrels of oil
MMCF	million cubic feet
MMCFG	million cubic feet of gas at one atmosphere pressure
MMCFD	million cubic feet per day
mph	miles per hour
MSDS	Material Safety Data Sheet
MSHA	Mine Safety Hazard Administration
MSLE	Modified Soil Loss Equation
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act of 1969
NPC	Northwest Pipeline Company
NO_2	nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NOS	notice of staking
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NSO	no surface occupancy
NWI	National Wetlands Inventory
NWR	National Wildlife Refuge
OHV	off-highway vehicle

OSHA	Occupational Safety and Health Administration
PAW	Petroleum Association of Wyoming
PI	Petroleum Institute
PLS	pure live seed
PM_{10}	particulate matter less than 10 microns in size
POD	plan of development
ppg	parts per gallon
PPP	Pollution Prevention Plan
PSD	Prevention of Significant Deterioration
RCRA	Resource Conservation and Recovery Act
RFFA	reasonably foreseeable future action
RIP	Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin
RMP	resource management plan
ROD	record of decision
ROS	Recreation Opportunity Spectrum
ROW	right-of-way
SARA	Superfund Amendments and Reauthorization Act
SCRAM	Support Center of Air Models
sec/qt.	seconds per quart
SEO	State Engineer's Office
SHPO	State Historic Preservation Office (or officer)
SMA	surface management agency
SMEA	Supplemental Moxa Arch Environmental Assessment
SPCC	Spill Prevention and Control Countermeasure
SO_2	sulfur dioxide
SWPPP	Storm Water Pollution Prevention Plan
t/ac	tons per acre
t/ac/yr	tons per acre per year
t/yr	tons per year
TD	total depth
TDS	total dissolved solids
TPQ	threshold planning quality
tpy	total per year
TSP	total suspended particulates
TVD	true vertical depth
UCG	Underground Coal Gassification
UPRC	Union Pacific Resources Company
USDA	United States Department of Agriculture
USDI	United States Department of the Interior
USGS	U.S. Geological Survey
VQO	Visual Quality Objectives
VRM	Visual Resource Management
WAAQS	Wyoming Ambient Air Quality Standards
WDEQ	Wyoming Department of Environmental Quality
WGFD	Wyoming Game and Fish Department
WOGCC	Wyoming Oil and Gas Conservation Commission
WOS	Wildlife Observation System
WP	working pressure
WYDOT	Wyoming Department of Transportation
WYNDD	Wyoming Natural Diversity Database

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

S.0 INTRODUCTION

This draft environmental impact statement (DEIS) analyzes the impacts of drilling and production operations in the Expanded Moxa Arch Natural Gas Development area (Moxa) of southwestern Wyoming. The Moxa analysis area is located in Lincoln, Uinta, and Sweetwater counties, Wyoming, as shown in Exhibit 1-3. The analysis area is generally located within Townships 15 through 23 North (T15-23N), Ranges 111 through 113 West (R111-113W), 6th Principal Meridian. The Moxa analysis area encompasses approximately 476,261 acres of mixed federal, State, and private lands. Of this total, approximately 230,403 acres are managed by the U.S. Department of the Interior (USDI) Bureau of Land Management (BLM), 31,665 acres are managed by the USDI Bureau of Reclamation (BOR), 13,504 acres are managed by the State of Wyoming, and 200,689 acres are private lands.

This DEIS has been prepared pursuant to the National Environmental Policy Act (NEPA) and addresses two field development scenarios (Proposed Action and Alternative A) and a "No Action" alternative--Alternative B. **Chapter 1** defines the Purpose and Need for the proposed project. **Chapter 2** details the parameters of the Proposed Action, Alternative A, and the "No Action" alternative (Alternative B), as well as a summary of proposed mitigation and monitoring measures to avoid or reduce impacts proposed by the Moxa Operators (the Operators). **Chapter 3** discusses the areas and resources that would be affected under each alternative. **Chapter 4** examines the environmental consequences to each resource under each alternative and also provides a summary of additional mitigation measures by resource discipline which were identified during the analysis process. The mitigation measures and requirements describe how implementation of the Proposed Action or alternatives should be managed to ensure minimal impacts in the Moxa analysis area and adjacent lands. In general, it is expected that all anticipated impacts resulting from implementing the proposed project could be effectively and feasibly reduced (mitigated) with the measures presented in the mitigation summaries of Chapters 2 and 4. **Chapter 5** provides a short discussion and summary of mitigation and monitoring for the proposed project. **Chapter 6** summarizes the consultation and coordination accomplished with various federal, State, county, and local agencies, elected representatives, environmental and citizen groups, industries, and individuals potentially concerned with issues regarding the proposed drilling action.

The Proposed Action would increase drilling production in the Moxa analysis area by allowing the Operators to develop 1,325 well sites in the next ten years (610 well sites within the proven production area and 715 well sites from the flank area) in addition to existing operations, as well as development of related roads, pipelines and production facilities. The other two alternatives analyzed in this DEIS are 1) Alternative A which would allow the Operators to develop 795 well sites (610 well sites within the proven productive area and 185 well sites within the flank area) in addition to existing operations, with related roads pipelines, and production facilities and 2) Alternative B, the No Action alternative, which would disallow any further gas/oil development on federal lands beyond that currently authorized. Additional Application for Permits to Drill (APDs) and right-of-way (ROW) actions would be granted by the Wyoming Oil and Gas Conservation Commission (WOGCC) for State and private lands on a case-by-case basis.

Management of federal lands within the Moxa analysis area is provided by the Kemmerer Resource Area (KRA) Resource Management Plan (RMP) (USDI-BLM 1986). The proposed natural gas development project and alternatives are in conformance with management objectives provided in the RMP.

Natural gas drilling and development activities within the Moxa analysis area are authorized by the Moxa Arch Environmental Assessment/Decision Record (MAEA/DR) (USDI-BLM 1991), and the Supplemental EA (USDI-BLM 1992). The BLM's DR and Finding of No Significant Impact (FONSI) for the 1991 MAEA/DR allowed the authorization of necessary permits and ROWs for the Operators to implement various components of the natural gas development project such as access road construction, gas gathering pipeline systems, and other associated facilities.

Following completion of the 1991 MAEA/DR, 149 additional wells were drilled in the Moxa analysis area by the Operators from June 1991 through July 1992. Based on this additional drilling and production information, the Operators gained approval from the WOGCC in January 1992 to develop the Frontier

Formation with four wells per section rather than the previous two wells per section. This spacing allowed the Operators a more efficient and economical development of the natural gas reservoir, without drainage or depletion of adjacent wells. This request resulted in additional wells being drilled in the Moxa analysis area at a concentration level not analyzed in the 1991 EA/DR.

As a result of the approved down-spacing request by the WOGCC, the BLM approved a supplement to the 1991 MAEA/DR to analyze the effects of the increased well density to ensure that no unnecessary or undue degradation would occur that could not be mitigated. The supplemental EA was approved in July 1992.

From August 1992 until the present, approximately 250 additional wells were drilled in the Moxa analysis area. Currently, approximately 1,119 wells have been drilled, approximately 957 of which are producing within the Moxa analysis area.

Drilling attempts within the current productive area and adjacent lands within the Moxa analysis area have been successful. This has resulted in a request to the BLM by the Operators for an increase in the level of drilling and production activity on lands not analyzed in the previous two analyses. Also, an expansion area should be added (Exhibit 1-3) due to the potential for further drilling success on the flank areas of Moxa and because the Church Buttes Field south of Interstate 80 (I-80) is part of the Moxa Arch development.

The BLM has advised the Operators that an EIS would be required in view of the Operators' plans to drill additional in-fill locations and construct ancillary facilities within the Moxa analysis area in 1995 and beyond at levels not evaluated in previous analyses.

S.1 PROPOSED ACTION AND ALTERNATIVES

S.1.1 Proposed Action

The Proposed Action would provide an optimum development scenario of 1,325 additional production well sites (610 well sites within the proven production area and 715 well sites from the flank area) and related facilities. This scenario would allow Moxa Operators to fully develop natural gas reserves to WOGCC-approved spacing requirements. The precise number of wells, locations of the wells, and timing of drilling would be directed by the success of development drilling and production technology, and economic considerations such as the cost of development of leases having marginal profitability. This proposed development level also should provide consideration of topographic and environmental limitations within the Moxa analysis area (e.g., restricted accessibility resulting from terrain limitations, areas of crucial wildlife habitat with seasonal restrictions, etc.).

The Proposed Action would be developed within a ten-year planning period from late 1995 through 2005. The development scenario would affect approximately 8,838 acres resulting from pipeline construction (1,458 miles with a 50-ft ROW), 4,823 acres from access road construction (795 miles with a 50-ft ROW), and 6,625 acres from well sites (1,325 well sites with 5.0 acres of disturbance per site) bringing the total disturbance caused by the Proposed Action to 20,293 acres of land (4.3 percent of the Moxa analysis area). This development scenario would involve clearing land and constructing well sites, access roads, pipelines, and associated facilities. The total area of disturbance would be reduced during the production phase through reclamation of disturbances associated with the unused portion of road ROW, pipeline ROW, and drill sites. As such, under the Proposed Action, total disturbance would be reduced from approximately 20,293 acres to approximately 5,691 acres.

The Moxa analysis area is not pristine. The analysis area has been subjected to numerous land-disturbing activities. Existing disturbance in the Moxa analysis area from the construction of existing drill/well sites, roads, pipelines, and facilities was approximately 25,999 acres, or approximately 5.5 percent of the total 476,261-acre analysis area. A large portion of this disturbance has been or is in the process of being successfully reclaimed. Approximately 12,034 acres have remained disturbed due to active facilities (e.g., roads, towns, railroads, etc.) and on-going operations (e.g., mines). Cumulative unreclaimed disturbance with implementation of the Proposed Action would be 17,725 acres (5,691 acres plus 12,034 acres) or 3.7 percent of the analysis area.

S.1.2 Alternative A

Alternative A would provide a reduced-level development scenario of 795 additional production well sites (610 well sites within the proven productive area and 185 well sites within the flank area) in addition to existing operations, with related roads, pipelines, and production facilities. Implementation of this alternative would involve 477 miles of new road and 875 miles of new gas-gathering pipeline. Construction of this alternative would involve 3,975 acres of drill site disturbance, 2,894 acres of road disturbance, 5,303 acres of pipeline disturbance, and seven acres of compressor station disturbance, for a total disturbance area of approximately 12,179 acres. As with the Proposed Action, a large portion of this area would be reclaimed, thus reducing the total disturbance by 8,762 acres to a total of 3,417 acres. This development scenario would also be completed over the ten-year planning period. Cumulative unreclaimed disturbance with the implementation of Alternative A would be approximately 15,451 acres (12,034 acres plus 3,417 acres), or 3.2 percent of the analysis area.

S.1.3 Alternative B - No Action

Alternative B, the "No Action" alternative, implies that the on-going natural gas production activities would be allowed to continue by the BLM in the Moxa analysis area, but the Proposed Action or Alternative A would be disallowed. Additional Applications to Drill (APDs) and ROW actions would be granted by the BLM on a case-by-case basis. Transport of natural gas products would be allowed from those wells within the analysis area that are currently productive. Cumulative disturbance with the implementation of the No Action alternative would be limited to the existing unreclaimed disturbance area of 12,034 acres plus unreclaimed disturbance areas associated with potential development on private and State lands, or approximately 2.5+ percent of the analysis area.

S.2 MAJOR IMPACT CONCLUSIONS

The Expanded Moxa Arch Natural Gas Development area proposal could cause direct and indirect, short-term and long-term, and cumulative disturbances of the human and natural environments. Potential environmental impacts that could result from implementation of the Proposed Action and Alternatives A and B are summarized in Section 2.6 of Chapter 2 and detailed in Chapter 4 of this EIS. A summary of proposed mitigation and monitoring measures to avoid or reduce impacts as committed by the Moxa Operators are presented in Chapter 2. Chapter 4 presents the results of the environmental impact analysis for each resource discipline. The following sections summarize the results of the environmental impact analysis by resource discipline. The commitment to apply mitigation is to federal lands; private and State lands may not have the same level of protective measures. Because 45 percent of the analysis area contains private and State lands, impact avoidance or reduction can be assured only on federal land. Not implementing mitigation measures on all lands affected could result in increased severity and magnitude of impacts summarized below. Chapter 4 provides additional discussion in regard to differential application of mitigation and resultant impacts for each resource discipline.

S.2.1 Range Resources and Other Land Uses

Impacts on range resources would involve loss of livestock forage, potential for livestock loss through theft or vehicular collision, and the introduction of weed species. Most of these impacts would be short term, lasting only as long as construction activities were on-going. Implementation of the Proposed Action would initially remove approximately 1,590 animal unit months (AUMs) of forage from production during drilling, access road, and pipeline construction (short-term loss of forage). Following reclamation and re-establishment of suitable range forage, approximately 265 AUMs would be lost through the ten-year planning period. This would be a reduction of less than one percent of the current livestock forage use in Moxa analysis area. The forage production removed under Alternative A is approximately 948 AUMs in the short term (initial construction and production phases). Following reclamation, approximately 158 AUMs would be lost through the ten-year planning period. The conditions described in Chapter 3, Affected Environment would generally remain unchanged under Alternative B (No Action) on federal lands. Once production operations are underway and reclamation measures completed, impacts to livestock operations would be minimal. With implementation of the mitigation measures proposed by the Moxa Operators (Chapter 2), and stipulations in the RMP, impacts to range resources and other land uses can be avoided or reduced to acceptable levels.

S.2.2 Air Quality

Implementation of the Proposed Action or Alternative A would result in the construction and operation of additional well sites in the Moxa analysis area. These actions would not have significant air quality impact or cause exceedances of the air quality significance criteria. The airborne pollutant concentrations that would result from the increased well site emissions would meet all Wyoming and federal ambient air quality standards, and would comply with applicable Prevention of Significant Deterioration (PSD) increments. The impact to air quality-related values (AQRVs, including visibility, acid deposition, and soils/vegetation) would also be below significance criteria levels. Under Alternative B (No Action), the on-going and previously authorized natural gas production activities would be allowed to continue on federal lands in the Moxa analysis area. Air pollutant emissions from existing sources would continue, and no exceedances of significance criteria would occur. Mitigation measures discussed in Chapter 2 should reduce impacts to air quality for all alternatives.

S.2.3 Transportation

Transportation effects of the Proposed Action and Alternative A would occur primarily on U.S. Interstate 80 (I-80), U.S. Highway 30 (U.S. 30), U.S. Highway 189 (U.S. 189), and Wyoming Secondary Highways 372 (WY 372) and 240 (WY 240). The Proposed Action would generate increases in traffic volumes on highways leading to the analysis area and on county and operator maintained roads within the analysis area. These increases would result from the movement of workers, equipment and materials to and from the analysis area to perform drilling field development, well service, field operations, and reclamation activities. Additionally, in order to perform the well field development activities associated with the Proposed Action, new access roads would be required. A total of approximately 795 miles of new access roads would be associated with the Proposed Action. Implementation of Alternative A would result in transportation impacts decreased by 60 percent of those described for the Proposed Action. Increase in traffic associated with the Proposed Action and Alternative A would not be significant under the thresholds established for this analysis. Under Alternative B (No Action), current traffic levels on the highways within the analysis area could decline if there is no additional well drilling and field development-related traffic. Transportation conditions under Alternative B would be similar to those described in Alternative A.

The increases in traffic associated with the Proposed Action, and to a lesser degree, Alternative A would create direct impacts when compared to Alternative B. These impacts would occur throughout the ten-year drilling program. Due to good condition and excess capacity of the highways within the analysis area, these impacts are not considered significant.

S.2.4 Geology/Minerals/Paleontology

Potential for impacts on project facilities due to seismic activity is low, as would be the potential for landslides and road subsidence that would temporarily close access roads. No significant impacts to important surface resources or other mineral resources would occur under the Proposed Action. Adverse interaction between oil and gas exploration and development and trona mining in the Moxa analysis area could result from the proposed project. Adverse effects could include the intrusion of natural gas into trona mining operations. The BLM has recently established a cementing policy (in consultation with the WOGCC, the Petroleum Association of Wyoming (PAW), and the Moxa Operators--see Chapter 2), that would reduce the potential occurrence of such an adverse effect.

Implementation of the Proposed Action and Alternative A would result in the construction in and excavation of surface and bedrock associated with the development of well pads, access roads, pipelines and other production facilities which could directly result in the exposure and damage or destruction of scientifically significant fossil resources. The potential magnitude of impact on fossil resources associated with the action alternatives (the Proposed Action and Alternative A) would vary proportionally with the total number of wells which would be developed under each alternative. The magnitude of impact for Alternative B (No Action), which would allow additional APDs and ROW action on a case-by-case basis, is unknown at present and would depend on the specific action taken and the specific area involved.

Mitigation measures discussed in Chapters 2 and 4 should reduce potential impacts to mineral/paleontologic resources. Beneficial impacts under the action alternatives include the unanticipated discovery of previously unknown fossils which could occur as a result of construction anywhere in the analysis area. Implementation of the No Action alternative could cause a failure to recover the federal natural gas resource.

S.2.5 Soils

Successful reclamation is a challenge in the Moxa analysis area due to low precipitation, high evaporation, shallow and rocky soils, and high salinity and alkalinity levels. The Moxa analysis area is not pristine and has been subjected to approximately 25,999 acres of cumulative soil disturbance from construction activities. However, a large portion of this area has been reclaimed or is in the process of being reclaimed leaving an approximate total unreclaimed area of 12,034 acres or 2.5 percent of the Moxa analysis area.

Potential impacts resulting from drill pad, access road, facility site, and pipeline ROW construction could include removal of vegetation, exposure of the soil, mixing of soil horizons, soil compaction, loss of topsoil productivity, and increased susceptibility of the soil to wind and erosion resulting in difficult reclamation. Soil erosion could result in sedimentation of stream channels. Implementation of the Proposed Action and Alternative A would initially affect 20,293 acres and 12,179 acres of soils, respectively, during project construction. This would represent approximately 4.3 percent and 2.6 percent of the analysis area for the Proposed Action and Alternative A, respectively. Alternative B, the No Action alternative, could continue to add to the existing disturbance in the Moxa analysis area as APDs are granted by the BLM. Prime farmlands and farmlands of State and local importance would not be affected by the proposed project, as no such areas occur in the analysis area. Reclamation efforts during well production would reduce impacts of the Proposed Action to 5,691 acres, and 3,417 acres for Alternative A.

A large portion of the Moxa analysis area falls into a sensitive soil category, providing limitations to road and facilities construction, rapid to very rapid runoff potential, and severe to very severe wind and water erosion potential. Although sensitive soils cannot be totally avoided, steep slopes greater than 25 percent, badlands, sand dune soils, and soils with high water tables and/or which are subject to inundation should be avoided. These impacts could be kept to non-significant levels with application of mitigation measures proposed in Chapter 2 and reclamation guidelines presented in Appendix B, as appropriate.

S.2.6 Water Resources

Construction of drill sites, access roads, pipelines, and ancillary facilities under the Proposed Action and Alternative A could cause increased surface water runoff and off-site sedimentation due to soil disturbance and erosion; increased salt loading and water quality impairment of surface waters; changes in stream discharge due to project disturbance; changes in groundwater levels, quantity, and quality; and channel morphology changes due to road and pipeline crossings. Under Alternative B, water resources within the Moxa analysis area would remain as described in the Affected Environment (Chapter 3); however, an unknown magnitude of additional development above the existing condition could occur as additional individual APDs were approved.

The magnitude of impacts to water resources would depend on the proximity of the disturbance to the drainage channel, slope aspect and gradient, degree and area of soil disturbance, soil character, duration of time within which construction activities would occur, and the timely implementation of mitigation measures. Impacts would likely be greatest shortly after the start of construction activities and would likely decrease in time due to natural stabilization, reclamation, and revegetation efforts. The Proposed Action would require approximately 2,195 acre-feet (ac-ft) of water over the ten-year planning period or 220 ac-ft per year for construction, pipeline tests, and well completion activities. Alternative A would require approximately 1,317 ac-ft over the ten-year period or 132 ac-ft per year. The proposed project could result in effects on trona mining in the analysis area due to mixing of groundwater of varying quality and intrusion of natural gas into trona mining operations. Mitigation measures discussed in Chapters 2 and 4, measures and guidelines presented in Appendices A and B, and other mitigation measures outlined in the Soils and Vegetation sections should acceptably reduce impacts to water resources.

S.2.7 Fisheries

Although the intermittent tributary drainages in the Moxa analysis area do not support fish populations, the Proposed Action and alternatives have the potential to affect fisheries resources and associated values downstream in the Hams Fork, Blacks Fork, Smiths Fork, and Green rivers. The principal fisheries impacts likely to be associated with the Proposed Action and alternatives include increased stream sedimentation, downstream water pollution from accidental discharge of toxic substances, and water flow depletions from the perennial rivers. However, given the avoidance and mitigation measures proposed by the Moxa Operators and those described in the RMP, no significant impacts are expected.

S.2.8 Vegetation/Wetlands

Direct impacts would include the short-term loss of vegetation (modification of structure, species composition, and areal extent of cover types). Indirect impacts would include the short-term and long-term increased potential for weed invasion, establishment, and expansion; exposure of soils to accelerated erosion; shifts in species composition and/or changes in vegetative density; reduction of wildlife habitat, and changes in visual aesthetics.

Implementation of the Proposed Action and Alternative A would initially affect 20,293 acres and 12,179 acres of various vegetation cover types, respectively, during project construction. This would add to the existing 12,034 acres of existing unreclaimed disturbance in the Moxa analysis area. Direct impacts include the short-term loss of vegetation (modification of structure, species composition, and areal extent of cover types). Indirect impacts include the short-term and long-term increased potential for weed invasion, establishment, and expansion; exposure of soils to accelerated erosion; shifts in species composition and/or changes in vegetative density; reduction of wildlife habitat; and changes in visual aesthetics. Under Alternative B (No Action), vegetation would continue to be impacted as some APDs are granted by the BLM on a case-by-case basis. Except for waters of the U.S., a reduction in vegetation density would not be significant because upland vegetation types are relatively common, cover large areas, have wide distribution and occur with high frequency within the analysis area. (See Section S.2.10 for effects on special status plant species.) Although project implementation could potentially impact the area and functions of wetlands, measures imposed by the RMP and the federal Clean Water Act (CWA) Section 404 permitting process would prevent or avoid impacts to jurisdictional wetlands and other special aquatic sites. Given implementation of Chapter 2 measures and mitigation, no significant impacts are anticipated. Reclamation would be accomplished according to a site-specific reclamation and revegetation plan that uses best management practices (BMPs).

S.2.9 Wildlife

The principal impacts on wildlife likely to be associated with the Proposed Action and alternatives include 1) the displacement of some wildlife species, 2) loss of certain wildlife habitats due to the development of drilling and production operations, 3) an increase in the potential for collisions between wildlife and motor vehicles, and 4) an increase in the potential for illegal kill and harassment of wildlife. The severity of these impacts would be expected to decrease with the completion of the construction phase and with the onset of reclamation efforts on many of the disturbed areas.

The nature of impacts to wildlife is identical between the Proposed Action and Alternative A. The magnitude of potential impacts would be greater under the Proposed Action due to the greater number of well sites and miles of associated access roads.

Implementation of the Proposed Action would result in the short-term loss of approximately 20,293 acres of wildlife habitat over the next ten-year planning period. These habitat alterations would diminish as vegetation becomes re-established along the pipeline ROW, beginning the first fall after wells start producing, and would continue with the subsequent reclamation of abandoned well sites that are no longer productive. With reclamation during the production phase, the total unreclaimed disturbance would be reduced to 5,691 acres. Removal of shrub habitat within the analysis area would represent a long-term loss to those species that depend on such vegetation for forage or shelter.

Similar to the Proposed Action, implementation of Alternative A would result in the short-term loss of approximately 12,179 acres of wildlife habitat over the next ten-year planning period. With reclamation during the production phase, the total unreclaimed disturbance would be reduced to 3,417 acres. Impacts due to wildlife habitat loss would be from 40 (short-term) to 60 (long-term) percent less than with the Proposed Action.

Under the No Action alternative, impacts related to wildlife resources within the analysis area and adjacent lands would be affected through on-going activities as authorized under previous environmental documentation and through unquantified additional development that could occur on State and private lands.

With the implementation of avoidance and mitigation measures presented in Section 2.2.4.2.9 and Section 4.9.6 and adherence to management measures prescribed in the RMP, potentially adverse impacts to wildlife resources would be directly avoided or reduced in severity.

S.2.10 Special Status Species

Special Status Plants

All project alternatives have the potential to affect special status plant species and habitat. Direct impacts to special status plant species would include death or injury to individual plants and/or loss of habitat due to vegetative clearing and earth-moving activities such as would occur during well site construction, pipeline placement, or access road construction. Indirect impacts would include the short-term and long-term increased potential for weed invasion, establishment, and expansion; exposure of soils to accelerated erosion; shifts in species composition and/or changes in vegetative density; impacts of fugitive dust on photosynthetic capacity; stream dewatering; or changes in stream channel hydraulics as a result of road or pipeline placement. The latter two could affect Ute ladies'-tresses in particular.

Avoidance of wetlands, barren lands, agricultural lands, and areas with steep slopes would reduce the potential for impacts to Opal phlox, Beaver Rim phlox, and Ute ladies'-tresses orchid, King's milkvetch, spinyleaf milkvetch, Eastwood plant, desert cryptantha, Swallen mountain ricegrass, Payson beardtongue, and dense twinpod. Such efforts at avoidance, however, could potentially increase the impacts to special status plant species found in non-sensitive soils within the mixed desert shrub cover type (i.e., contracted Indian ricegrass) and areas of alkali scrub (i.e., large-fruited bladderpod) as well as species such as spinyleaf milkvetch and desert cryptantha that are found on sandy soils. The magnitude of such impacts cannot be defined without site-specific information on the location of proposed facilities or site-specific surveys for rare plants/habitats.

Given compliance with the Endangered Species Act (ESA) and the RMP, implementation of measures identified in Chapters 2 and 4, and any additional measures identified by the BLM following surveys of facilities location sites, significant direct impacts to special status plant species are not anticipated. Implementation of mitigation measures to prevent/reduce fugitive dust and the potential for noxious or undesirable weed introduction and spread in areas of potential habitat would minimize the potential for negative indirect effects. With implementation of the clearance requirements for threatened, endangered, and candidate species, the Proposed Action and Alternative A are not likely to affect threatened or endangered species or contribute to the need to list candidate plant species.

Special Status Animals

Three wildlife species listed as endangered by the U.S. Fish and Wildlife Service (FWS) under the ESA have the potential for occurrence in the analysis area. These include the black-footed ferret, bald eagle, and peregrine falcon. In addition, eight candidate species have the potential for occurrence in the analysis area: Preble's shrew, pygmy rabbit, white-faced ibis, ferruginous hawk, mountain plover, long-billed curlew, black tern, and loggerhead shrike. The burrowing owl, a species listed as Rare by the Wyoming Game and Fish Department (WGFD), could also have the potential for occurrence in the analysis area.

With the implementation of either the Proposed Action or Alternative A, direct loss of potential habitat would result from surface disturbance associated with the construction of well sites and related access roads and pipelines. In addition, some wildlife species would be indirectly impacted by displacement from habitats in the vicinity to the analysis area due to the presence of human activities associated with the construction and operation of wells. The potential for collisions between wildlife and motor vehicles would also increase due to the construction of new roads and increased traffic levels on existing roads. The severity of these impacts would be expected to decrease with the completion of the construction phase and with the onset of reclamation efforts on many of the disturbed areas.

No adverse impacts to listed wildlife species are expected given the implementation of avoidance and mitigation measures presented in Sections 2.2.4.2.9 and 4.9.6, adherence to management measures prescribed in the RMP, and compliance with the ESA. The Proposed Action and Alternative A are not likely to affect threatened or endangered species or contribute to the need to list candidate animal species.

Special Status Fish

Potential impacts to fisheries resources include the degradation of surface water quality, an increase in stream flow from surface runoff, and a decrease in stream flow from the consumption of groundwater. However, given the avoidance and mitigation measures described in Chapters 2 and 4, neither the Proposed Action nor Alternative A are likely to affect the listed fish species or contribute to the need to list candidate fish species.

Because the endangered and threatened species are so far removed from the Moxa analysis area, no direct effects to them are anticipated. Although unforeseen, any potential indirect effects that might be created by water depletion impacts would be reduced to non-significant levels through implementation of the "Windy Gap Process." According to the "Windy Gap Decision" of the FWS (as amended July 5, 1994), any average annual depletion in excess of 125 ac-ft to the upper basin is considered to have a possible effect on the survival and recovery of these endangered species of fish in the Colorado River System. This decision provides for the payment into a conservation fund for annual depletions within the upper Green River basin over 125 ac-ft. Although the flows of many tributaries in the upper basins have been modified, flow in the mainstem Green River is controlled by the Flaming Gorge Reservoir, and the resultant impacts on fish habitat are difficult to access. Therefore, the "Windy Gap Process" was developed to facilitate the calculation of flow depletions on a cumulative basis and the assessment of user fees to promote recovery of these species through monitoring research, habitat manipulation, and fish culture. Since the Proposed Action and Alternative A would require an estimated average annual depletion of 220 and 143 ac-ft per year, respectively, payment to the FWS conservation fund would be required. (The 1993/94 rate was $12.34/ac-ft.)

S.2.11 Visual Resources

Both short-term and long-term impacts to the visual resource could be possible where patterns of area, line, form, color, and texture in the characteristic landscape would be contrasted by drilling equipment, production facilities, and/or construction-related damage to vegetation, topography or other visible features. The severity of impact depends upon scenic quality, sensitivity level, and distance zone of the affected environment, reclamation potential of the landscape disturbed, and the level of disturbance to the visual resource created by the proposed action. In general, impacts would be most severe on sites where mitigation would be difficult and where visual contrasts would be highly visible to potentially large numbers of viewers such as from Fontenelle Reservoir, the Green River, U.S. 30, and I-80. In general, these areas include Visual Resource Management (VRM) Class zones II and III.

Adverse impacts from well construction would occur within the short term due to contrast in line, form, color and textures associated with equipment, surface disturbance, and fugitive dust juxtaposed with the existing landscape. Long-term impacts would result from production facilities, access roads, pipelines, and fugitive dust. When comparing the three alternatives, it was assumed that an equal percentage of wells would be located in the critical I-80, U.S. 30, and WY 189 viewsheds. Impacts would be greatest under the Proposed Action because the largest number of wells, roads and pipelines would be associated with this action. Thus the largest area of disturbance would result from implementing the Proposed Action. The Proposed Action would produce significant impacts if all potential well locations were developed in the Class II and Class III zones. Impacts in the Class IV zone would not be considered significant.

Impacts associated with Alternative A would be substantially lower than those of the Proposed Action. Whether or not these impacts would also be considered significant would depend upon how many wells would be drilled in Class II and III VRM zones. Any wells drilled in Class II that are not screened and more than two wells per square mile in Class III would constitute a significant impact unless screened from view.

Impacts associated with the No Action alternative could be considerably less than those of the Proposed Action. Impacts associated with any well site development in Class II areas would be considered significant unless they were screened from view. Impacts in Class III areas would not be considered significant unless well densities exceeded two well sites per square mile.

S.2.12 Noise

Implementation of the Proposed Action and alternatives has the potential to create noise-generated impacts that emanate from machinery utilized during the construction of drill sites, pipelines, access roads, and ancillary facilities, and from the operation of heavy trucks and related equipment. Given the low human population densities in the Moxa analysis area, construction and development operations under the Proposed Action and alternatives would be sufficiently distant from residences that none would likely be affected by construction or development operations. Overall noise produced by construction and support services equipment during peak activity periods would be moderate because of its dispersed and short-term nature. Implementation of mitigation measures in Sections 2.2.4.2.12 and 4.12.6 should fully mitigate or reduce all noise impacts to levels not considered significant.

S.2.13 Recreation

Well drilling, testing and production operations, and associated site preparation and construction activities such as those proposed for the Moxa analysis area have the potential to cause alterations to the recreation setting and recreation opportunities available to persons using the area. Some recreationists could be temporarily or permanently displaced from using certain locations associated with drilling and production activities. Displacement of recreationists could also result from changes in the numbers or distribution patterns of wildlife that attract hunters and wildlife observers to the area. Conflicts could develop between an increased number of workers associated with natural gas production and hunters in regard to hunters' stray bullets and/or arrows. The presence of construction and drilling equipment and associated increased evidence of human industrial activities in the area could reduce opportunities for recreationists seeking to experience solitude and isolation from human activity. Such changes could also result in displacement or redistribution of recreationists who would choose to avoid such conditions, as well as reduced satisfaction among others who might continue to engage in recreation activities in the area.

The impact of drilling and construction on the recreation resource under the Proposed Action would involve the temporary displacement of some hunters; particularly during the Pronghorn season when use is highest. Theoretically, many hunters could relocate to other hunting areas within or near the Moxa analysis area. However, the number of proposed mineral extraction activities in the region would make relocating increasingly difficult over time for hunters seeking solitude and isolation as part of their outdoor experience. In addition, anglers recreating on Fontenelle Reservoir and the Green and Hams Fork rivers could also be adversely impacted if drilling occurs within the viewsheds of these recreation sites.

Short-term impacts associated with drilling activities could also contribute to a deterioration of the experience of non-consumptive backcountry recreationists who may continue to use the area. These impacts would be most pronounced if drilling activities were scattered throughout the field during the ten-year planning period.

Overall, these impacts would not be considered significant at any one drilling site due to the short-term nature of project activities. However, when considering the increased level of activity within the entire 748 square-mile Moxa Arch Field, there could be a deterioration in the quality of the recreation experience throughout the area by the year 2005.

Production and storage facilities would remain once drilling was completed. The visible presence of these facilities and activities could have a negative impact on some hunters and backcountry users. These impacts would be similar to those discussed as short-term impacts and could lead to user displacement. Increasingly limited opportunities for recreationists to relocate into suitable nearby areas would increase the potential for recreationist dissatisfaction. As noted in Chapter 3, the improved access to backcountry locations associated with an increase in road density could attract a larger proportion of the hunter population seeking easier access into the Moxa analysis area. Impacts described above would persist for the life of the project.

Neither the Proposed Action nor the No Action alternative would have significant adverse impacts on recreation resources given measures in Chapter 2 (particularly Visual Resource Mitigation) and the RMP (USDI-BLM 1986) stipulations.

S.2.14 Socioeconomics

Implementation of the Proposed Action or Alternative A has the potential to create primarily positive socioeconomic impacts that could offer: 1) continued levels of employment in the regional oil and gas industry; 2) economic benefits in other sectors of the regional economy stemming from employee and industry spending; and 3) a source for generating additional tax revenues.

The Proposed Action would provide continued employment for local residents currently employed in the oil and gas drilling and field service industry. It is anticipated that the existing industry would be able to accommodate the Proposed Action based on past and current levels of oil and gas drilling and production activity and observed employment trends in the region. Since no in-migrant population is expected to result from the Proposed Action, no impact on local housing conditions is anticipated. The Proposed Action is also not anticipated to place additional demands on local government facilities or services. Additional tax revenues generated by the Proposed Action are anticipated to be substantial. Therefore, potential socioeconomic impacts associated with the Proposed Action are largely positive and not significant according to the thresholds used for this analysis.

Implementation of Alternative A would result in similar socioeconomic impacts as described for the Proposed Action. The number of local drilling, service and operations workers employed in the area would be reduced. Tax revenues for federal, State and local governments would be reduced due to the reduction in the number of wells drilled and the associated reduction in facilities and production of natural gas. The estimated reduction in sales and use tax revenues for each jurisdiction compared to the Proposed Action would be: Lincoln County (-29 percent); Sweetwater County (-48 percent); Uinta County (-45 percent); and the State of Wyoming (-40 percent). This alternative would also reduce the amount of state severance tax revenues, State and federal mineral royalties and ad valorem revenues (compared to the Proposed Action). The estimated reduction in Wyoming severance tax revenue and State and federal mineral royalties would be about 41 percent. The estimated reduction in total ad valorem tax revenues for each taxing entity in the three counties would be: Lincoln County (-30 percent); Sweetwater County (-51 percent); and Uinta County (-47 percent).

Implementation of Alternative B (No Action), would likely result in a reduction in employment in the oil and gas sector of the regional economy assuming no other, unassociated oil and gas development occurs within southwest Wyoming. A reduction in the area population would also be likely. The various sales and use tax, severance tax, mineral royalty, and ad valorem tax revenues associated with the Proposed Action and Minimum Development alternative could be lower, and the decline in Uinta County assessed valuation could continue.

S.2.15 Cultural Resources

The Moxa analysis area cultural resource database includes 2,994 sites, consisting of both prehistoric and historic components. The population of known prehistoric sites in the analysis area consists mostly of open camps and lithic scatters. Known historic site types within the analysis area include stockherding sites, trails/highways, ranches, railroad sites, and urban sites.

Moxa analysis area has a moderate to high site density and, therefore, high archaeological sensitivity. Consequently, impacts to specific eligible or unevaluated properties may occur with implementation of the proposed action or alternatives. Certain geomorphic situations have a greater archaeological potential than other areas especially in terms of significant cultural resources. These situations include eolian deposits (sand dunes, sand shadows and sand sheets), alluvial deposits along major drainages, and colluvial deposits along the low slopes of badlands and other steep topographic breaks.

Although the Moxa analysis area has a high degree of archaeological sensitivity, impacts to cultural properties would not be significant. Potential impacts to known and anticipated cultural resources can be alleviated through mitigation measures outlined in Chapter 2 and Chapter 4 of this EIS. With implementation of mitigation measures discussed in Chapters 2 and 4, no significant impacts to cultural resources would occur in the analysis area.

S.2.16 Health and Safety

Hazards associated with the drilling program, including construction and operation, are hazards normally associated with heavy construction and industrial work. Potential risks associated with the oil and gas extraction industry, including impacts from road, drill site, and pipeline construction, drilling operations, production operations and project traffic, would mostly be limited to employees and subcontractors. There would be a minor increased risk to the public caused by project implementation resulting from additional drilling and production related traffic in the Moxa analysis area. However, none of these impacts are expected to occur at significant levels. With implementation of mitigation measures in Chapters 2 and 4, no significant impacts should occur with respect to health and safety.

S.3 SCOPE OF ANALYSIS

The purpose of the scoping process, as stipulated (40 CFR, Parts 1500-1508), is to identify important issues, concerns, and potential impacts that require analysis in the EIS and to eliminate insignificant issues and alternatives from detailed analysis. A Scoping Statement was prepared and submitted to the public by the BLM on March 11, 1994, requesting input into the proposed Expanded Moxa Arch Area Natural Gas Development project. Scoping documents were sent out to the public on the BLM mailing list, as well as to organizations, groups, and individuals requesting a copy of the scoping document. During preparation of the DEIS, the BLM and consultant interdisciplinary team (IDT) have communicated with, and received input from various federal, State, county, and local agencies, elected representatives, environmental and citizen groups, industries, and individuals potentially concerned with issues regarding the proposed drilling action as summarized in Chapter 6.

S.4 SUMMARY OF CUMULATIVE EFFECTS

The cumulative effects of the two field development alternatives analyzed in this EIS are compared in the following text. The Proposed Action is the projected additional disturbance caused by the implementation of the maximum development program of 1,325 well locations. Alternative A represents a minimum level of additional site disturbance associated with the development of 795 wells.

Cumulative effects are impacts likely to occur due to the proposed project in combination with other on-going activities, recently constructed projects, and projects likely to be implemented in the near future. Cumulative effects are both additive and interactive. Chapter 4 discusses these effects under each resource discipline section. This section identifies the basic existing cumulative disturbance within the Moxa analysis area as a baseline for the analysis presented in Chapter 4 of each resource discipline section.

Taking past, current, and future reclamation into account, the total existing unreclaimed disturbance is approximately 12,034 acres or 2.5 percent of the 476,261-acre analysis area.

Site disturbance resulting from implementation of the Proposed Action and Alternative A would add cumulatively to the degree of disturbance within the Moxa analysis area. The 20,293 acres of short-term impact for the Proposed Action would increase the area of total disturbance within the Moxa analysis area to 46,292 acres, or 9.7 percent of the analysis area. Alternative A would bring the total disturbance to 38,178 acres (8.0 percent).

Successful reclamation of well, road, and pipeline construction activity would reduce the area of long-term disturbance by the Proposed Action to 5,691 acres with a cumulative disturbance of 17,725 acres (3.7 percent). Successful reclamation of Alternative A would reduce its long-term disturbance to 3,417 acres with cumulative disturbance of 15,451 acres (3.2 percent).

Table 2-5 presents a qualitative/quantitative comparison of impacts between the Proposed Action and Alternatives A and B for each resource element. Further details on the type and extent of impacts to each resource are presented in Chapter 4, Environmental Consequences. Additionally, Table 2-5 identifies compliance with applicable guidelines and indicates if impacts would be significant and unmitigable, significant but mitigable, or non-significant. Only Visual Resources has the potential for significant impacts, even with the mitigation measures presented in this chapter and with measures presented in Section 4.11.7. All other resources would experience either non-significant impacts or impacts that should be mitigated to non-significant levels.

S.5 AGENCY-PREFERRED ALTERNATIVE

The Proposed Action is the BLM's Preferred Alternative for the Moxa analysis area. This selection is based on the analyses presented in this EIS and incorporates compliance with the RMP and implementation of various mitigation measures. Such measures include the following: 1) proponent-committed project-wide measures for preconstruction planning and design and specific resources (Section 2.2.4), 2) BLM Standard Mitigation Guidelines and BOR Stipulations for Surface Use at Oil and Gas Well Drill Sites and Access Roads (Appendix A), 3) Reclamation Guidelines (Appendix B), 4) Hazardous Substances Management Plan (Appendix C), and 5) additional mitigation measures recommended in Chapters 4 and 5 for the various resources. The BLM has concluded that these detail a complete listing of practicable measures to reduce environmental harm resulting from the proposed development in the Moxa analysis area. The BLM also feels that the analyses demonstrate that the Proposed Action would meet the requirements of Federal Regulation 43 CFR 3162(a), which directs the Operators to conduct "all operations in a manner ... which results in maximum ultimate economic recovery of oil and gas with minimum waste ...."

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CHAPTER 1

PURPOSE AND NEED

CHAPTER 1

PURPOSE AND NEED

1.0 INTRODUCTION

1.1 PROJECT DESCRIPTION AND LOCATION

1.1.1 Description

Amoco Production Company (Amoco), Union Pacific Resources Company (UPRC), Wexpro/Celsius Energy Company, Bannon Energy, Marathon Oil Company, Presidio Exploration, and other oil companies (hereafter referred to as the "Operators"), have notified the Bureau of Land Management (BLM), Rock Springs District, Kemmerer Resource Area (KRA) that the Operators intend to drill additional development wells in the Moxa Arch area of southwestern Wyoming (Exhibits 1-1 and 1-2). Lands associated with the additional drilling program include those previously analyzed in the Amoco Production Company Moxa Arch Natural Gas Production Environmental Assessment (MAEA) and Decision Record (DR) (USDI-BLM 1991a), and the Supplemental EA to Amoco Production Company Moxa Arch Natural Gas Production Project (USDI-BLM 1992a). Additional areas to be included in this environmental impact statement (EIS) include lands to the north and south of the analysis area described in the previous EAs. The additional area combines with those lands analyzed in the previous two environmental analysis documents to form the Expanded Moxa Arch Natural Gas Development project (Moxa) analysis area (Exhibit 1-3).

1.1.2 Location

The Moxa analysis area is located in the mixed ("checkerboard") land ownership area of Lincoln, Uinta, and Sweetwater counties, Wyoming, as shown in Exhibit 1-4. The analysis area is generally located within Townships 15 through 23 North (T15-23N), Ranges 111 through 113 West (R111-113W), 6th Principal Meridian. The area is accessed by Interstate 80 (I-80), which crosses the south half of the area, and by U.S. Highway 30 as shown on Exhibit 1-2. Access to the interior of the Moxa analysis area is provided by an extensive road network developed to service prior and on-going drilling and production activities.

1.1.3 Project Background

Presently, the Moxa analysis area contains several natural gas fields and federal units, some of which are subject to active drilling programs (Exhibit 1-5, Tables 1-1 and 1-2). These fields are predominantly spaced for two or four wells per section depending on the field or unit. The Wyoming Oil and Gas Conservation Commission (WOGCC) approved an application in December 1991 to allow the drilling of four Frontier Wells per section in the Bruff, Fabian Ditch, Wild Hare Gulch, and Verne Fields units. The WOGCC has subsequently approved numerous applications to allow drilling of two or four wells per section.

Drilling activity is proposed for the federal units where spacing requirements are established and therefore would not require WOGCC approval prior to drilling. Other development wells within the Moxa analysis area that are not included in a federal unit would be drilled on the spacing pattern established by WOGCC Rule 302 for unspaced areas.

Current natural gas drilling and development activities within the Moxa analysis area have been authorized by the MAEA/DR (USDI-BLM 1991a), and the Supplemental EA (USDI-BLM 1992a). The BLM, Rock Springs District, completed the MAEA/DR in June 1991. Drilling and production activities authorized by the MAEA/DR began in the summer of 1991 and continued through December 1992. At the time the 1991 DR/FONSI was approved, the Moxa analysis area was an existing field of 312 wells, 115 of which were on federal surface/federal minerals.

Following completion of the 1991 MAEA/DR, 149 additional wells were drilled in the Moxa analysis area by the Operators from June 1991 through July 1992. Additional drilling provided the Operators more detailed information concerning the Frontier Formation reservoirs. Based on this additional drilling and production information, the Operators gained approval from the WOGCC in January 1992 to develop the Frontier Formation with four wells per section rather than the previous two wells per section. This spacing allowed the Operators a more efficient and economical development of the reservoir, without drainage or depletion of adjacent wells. Also, this spacing would

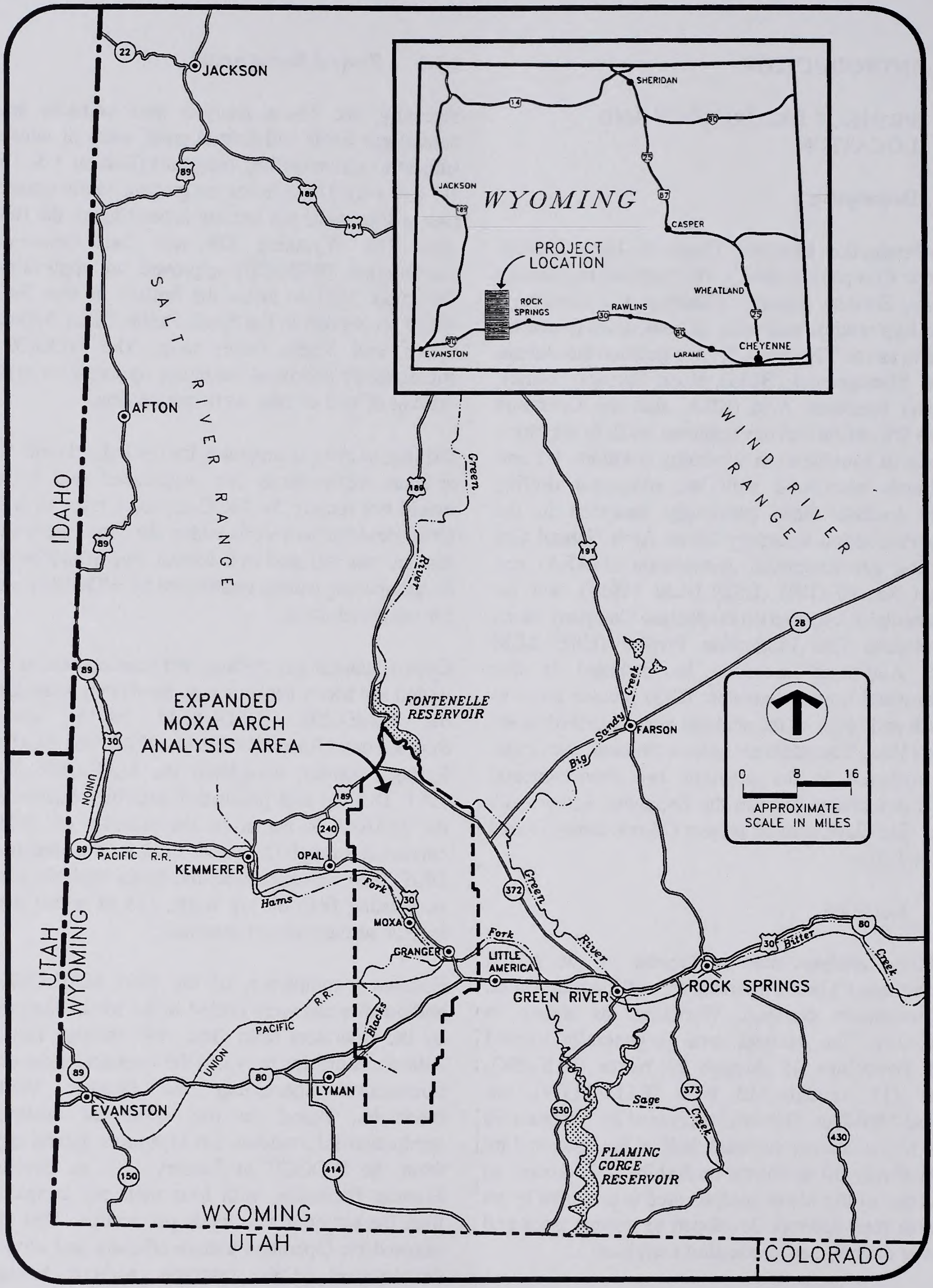

Exhibit 1-1. Area Map - Location of the Moxa Analysis Area in Southwestern Wyoming.

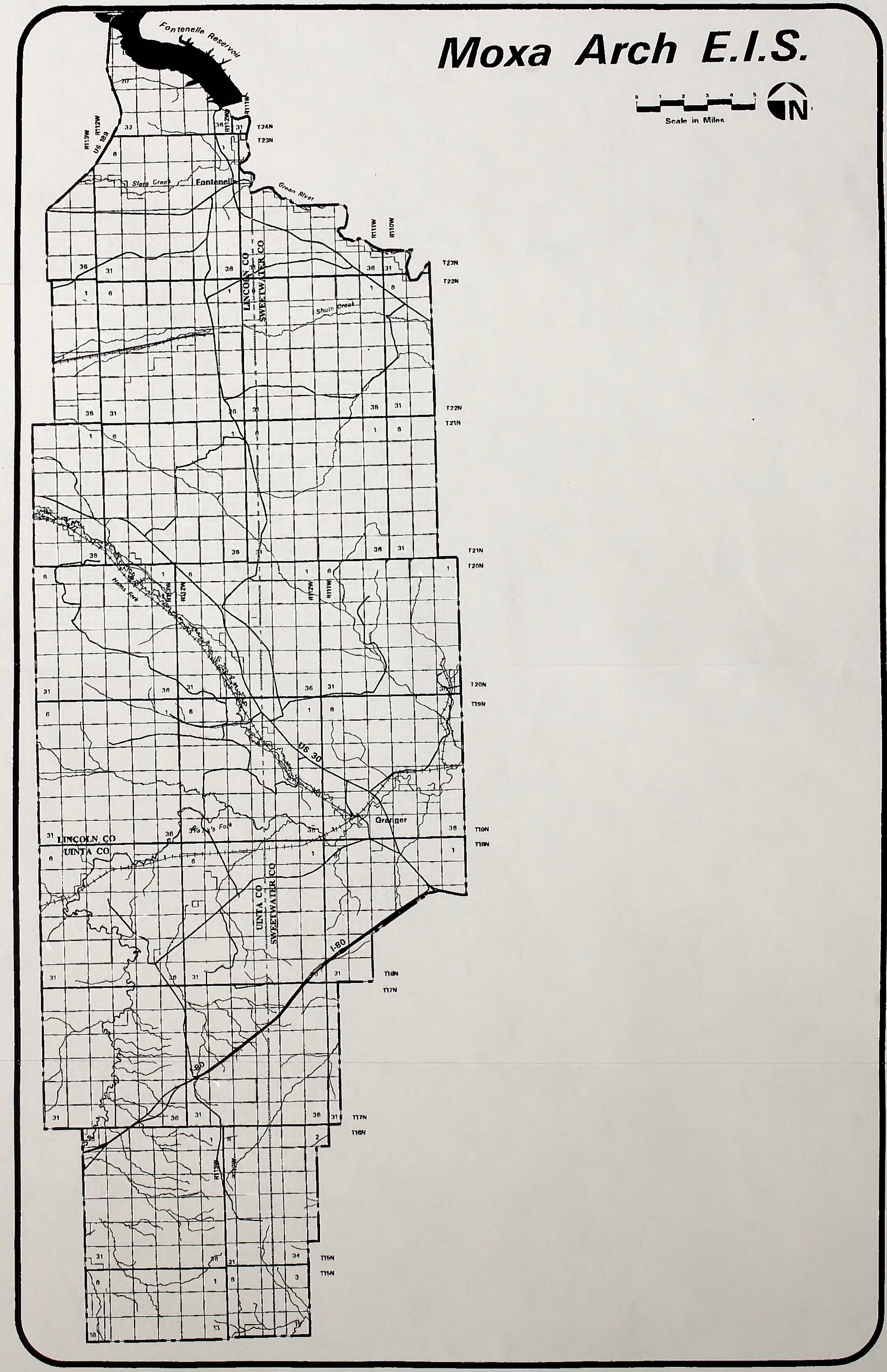

Exhibit 1-2. Vicinity Map.

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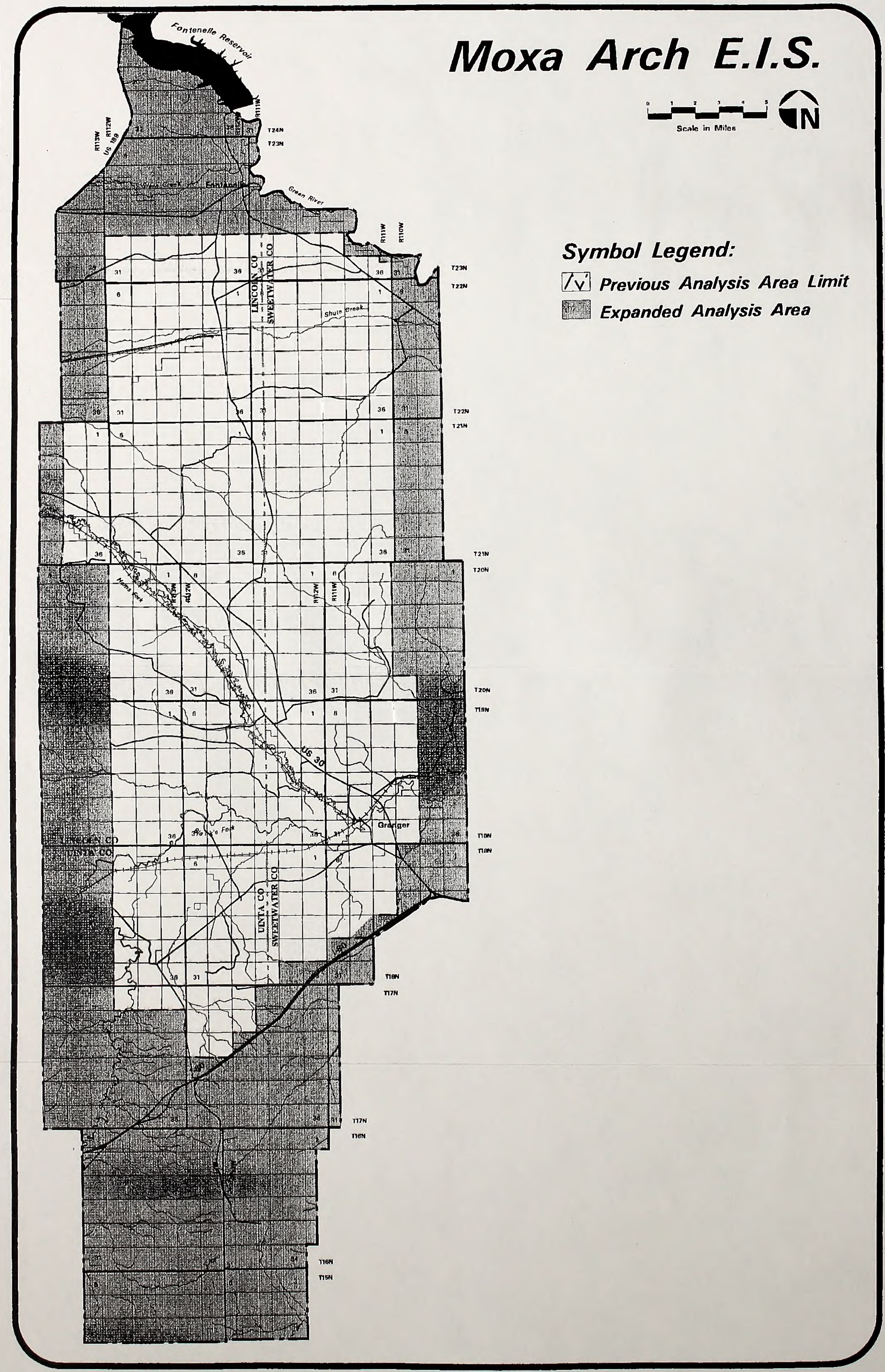

Exhibit 1-3. Map Showing Expanded Moxa Analysis Area.

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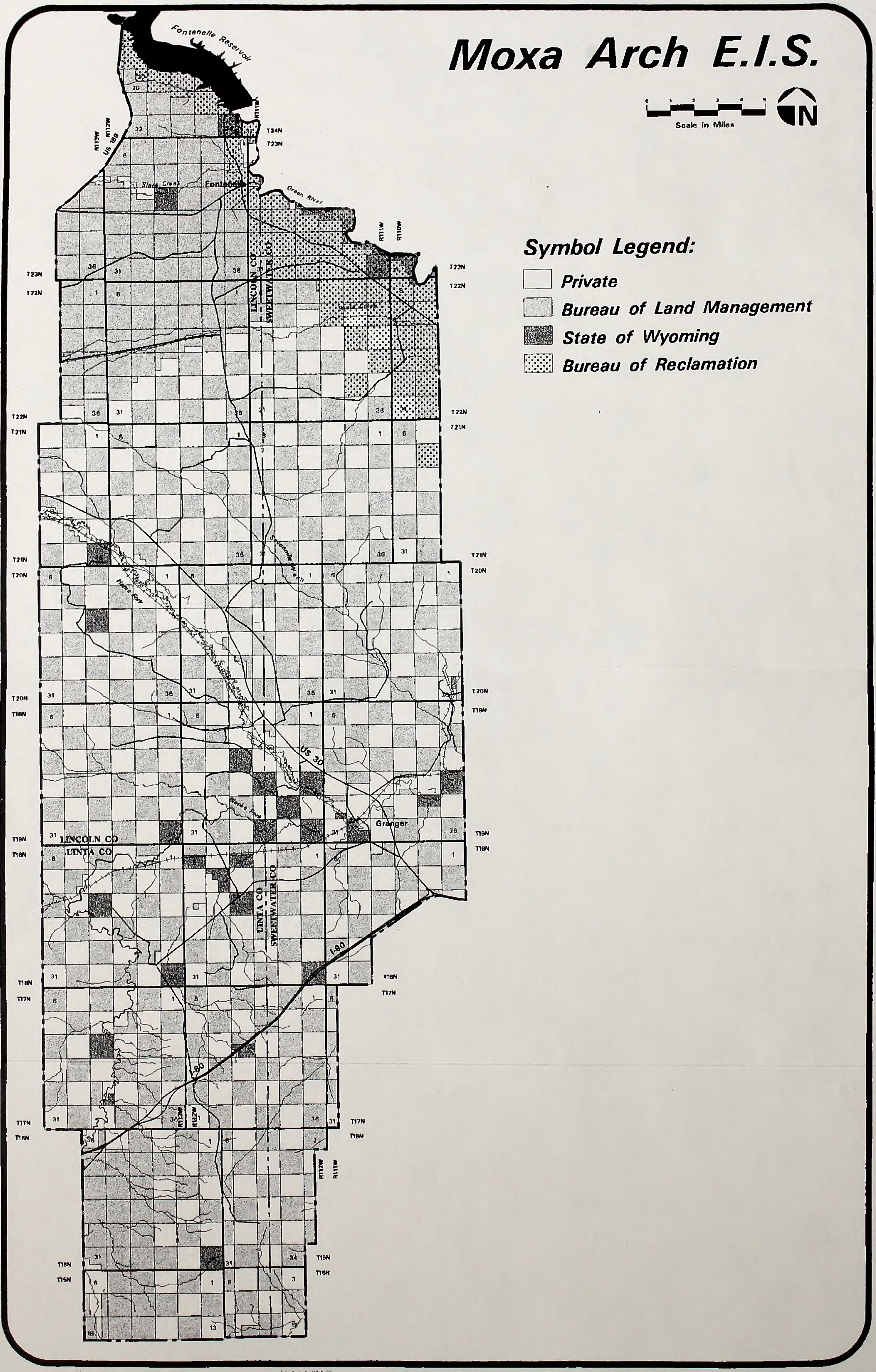

Exhibit 1-4. Surface Ownership within the Moxa Analysis Area.

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Table 1-1. Federal Units within the Moxa Analysis Area.

Unit Name	Operator	Size (acres)	Date Designated	Contracted	
				Date	Acres
Cow Hollow	Amoco	26,211.68	1/21/08	N/A	N/A
Whiskey Buttes	Amoco	74,716.85	12/27/93	4/7/83	18,287.44
Wilson Ranch	Amoco	25,716.68	9/5/72	11/1/87	9,796.21
Shute Creek	Amoco	21,028.78	7/18/74	4/4/85	7,644.82
Seven-Mile Gulch	Amoco	29,960.13	2/25/76	9/18/83	3,712.70
Bruff	Wexpro	9,000.00	6/29/72	5/12/78	7,760.00
Church Buttes	Wexpro	49,848.07	9/1/44	N/A	N/A
Storm Shelter	Presidio	14,361.48	11/27/74	6/30/80	2,880.00

Table 1-2. Fields (WOGCC Spacing Orders) within the Moxa Analysis Area.

Field Name	Required Spacing	Producing Formation	Docket No.	Date of Order
Bruff, et al.	4 wells per 640 acres	Frontier	414-91	12/3/91
Bruff, et al.	4 wells per 640 acres	Frontier	64-93	3/9/93
Bruff, et al.	4 wells per 640 acres	Frontier	65-93	3/9/93
Bruff, et al.	2 wells per 640 acres	Dakota	347-89	12/12/89
Seven-Mile Gulch	2 wells per 640 acres	Frontier/Dakota	5-91	1/8/91
Seven-Mile Gulch	4 wells per 640 acres	Frontier	361-93	10/12/93
Cow Hollow, et al.	2 wells per 640 acres	Frontier	286-93	8/10/93

allow additional wells to be drilled in the Moxa analysis area at a concentration level not analyzed in the 1991 MAEA/DR.

As a result of the approved downspacing request by the WOGCC, the BLM approved a supplement to the 1991 MAEA/DR to analyze the effects of the increased well density to ensure that no unnecessary or undue degradation would occur that could not be mitigated. The supplemental EA was approved in July 1992. At that time (July 1992), the Moxa analysis area consisted of 442 wells, 167 of which were on federal lands/federal minerals.

From August 1992 until the present, approximately 250 additional wells were drilled in the Moxa analysis area. Currently, approximately 1,119 wells have been drilled or have been approved for drilling within the Moxa analysis area. Of this total, 957 wells are currently producing natural gas. The remaining 162 wells were non-productive and have been plugged and abandoned.

Drilling attempts within the current productive area and adjacent lands within the Moxa analysis area have been successful. This has resulted in a request to the BLM by the Operators for an increase in the level of drilling and production activity on lands not analyzed in the previous two analyses. Also, expansion area should be added (Exhibit 1-3) because of the potential for further drilling success on the flank areas of Moxa, and because the Church Buttes Field south of Interstate 80 (I-80) is part of the Moxa Arch development.

The BLM has advised the Operators that an EIS would be required in view of the Operators' plans to drill additional in-fill locations and construct ancillary facilities within the Moxa analysis area in 1995 and beyond at levels not evaluated in previous analyses.

1.1.4 Land Status

The Moxa analysis area encompasses approximately 476,261 acres of mixed ("checkerboard") federal, state, and private lands. Of this total, approximately 230,403 acres are BLM, 31,665 are Bureau of Reclamation (BOR), 13,504 acres are State of Wyoming, and 200,689 acres are private lands. Surface ownership is summarized in Table 1-3 and shown in Exhibit 1-5.

1.2 PURPOSE OF AND NEED FOR ACTION

The Operators propose to expand the surface extent of the Moxa analysis area and increase the total number of wells and ancillary facilities where economically feasible. This proposal would enhance recovery of natural gas from the lease area, allowing all Operators to provide more natural gas to companies distributing and supplying natural gas to consumers, and would benefit consumers by making natural gas supplies available.

The development of federal gas leases is an integral part of the BLM gas leasing program under authority of the Mineral Leasing Act of 1920, the Federal Land Policy and Management Act of 1976, and the Federal Onshore Oil and Gas Leasing Reform Act of 1987. The BLM's Kemmerer Resource Management Plan (RMP) (USDI-BLM 1986), with public involvement, reviewed all public lands in the resource area and determined them to be suitable for oil and gas leasing and development, subject to certain stipulations.

The BLM oil and gas leasing program encourages development of domestic oil and gas reserves. Natural gas is an integral part of the United States' energy future due to its availability and the presence of the existing market delivery infrastructure. By developing domestic reserves of clean burning natural gas, the U.S. would reduce dependence on foreign energy, such as natural gas from Mexico and Canada. The environmental advantages of burning natural gas rather than oil or coal were emphasized by the U.S. Congress and by the President when the Clean Air Act Amendments of 1990 were signed into law.

The purpose of, and need for, the proposed natural gas development is to exercise the lease holders' rights within the Moxa analysis area to drill for, extract, remove, and market gas products. Also included is the right of the Moxa area lease holders to build and maintain necessary improvements, subject to renewal or extension of the lease or leases in accordance with the appropriate authority.

1.3 PURPOSE OF THE ENVIRONMENTAL ANALYSIS PROCESS

The purpose of this EIS is to provide the decision-makers with information needed to make a final decision that is fully informed and based on factors relevant to the proposal. It also documents analyses conducted on the proposal and alternatives in order to identify environmental impacts and mitigation measures necessary to address issues. The EIS also provides a vehicle for public review and comment on the Moxa proposal, the environmental analysis, and conclusions about the relevant issues.

This EIS analyzes the effects of well pad locations, access roads, production facilities, pipelines, and other facilities associated with natural gas development on resources and land use within the Moxa analysis area.

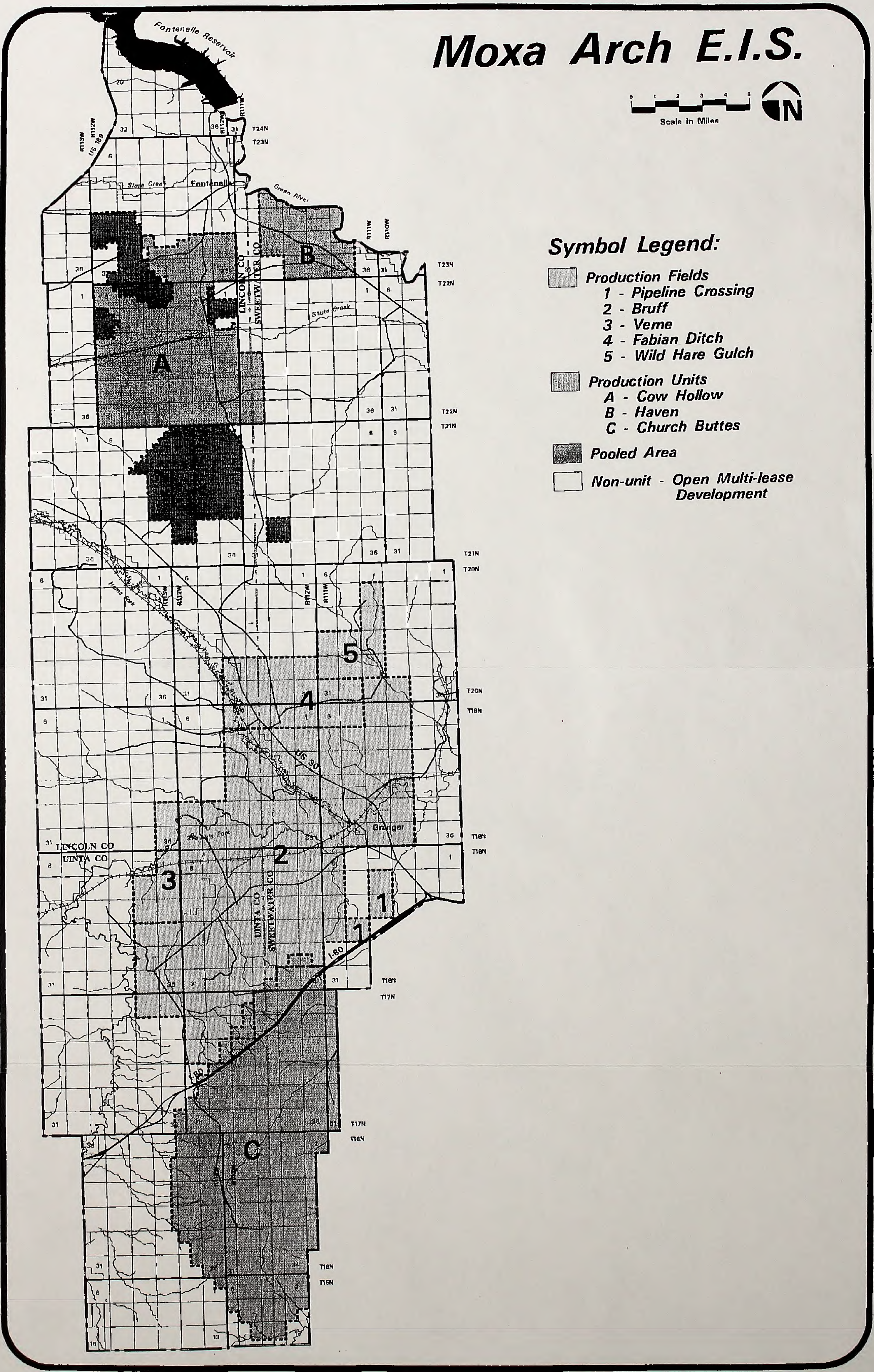

Exhibit 1-5. Map Showing Locations of Units/Spacing Orders.

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Table 1-3. Surface Ownership of the Moxa Arch Analysis Area.

Surface Ownership	Acres	Percent
Private	200,689	42.1
Federal		
BLM	230,403	48.4
BOR	31,665	6.7
State of Wyoming	13,504	2.8
TOTAL	**476,261**	**100.0**

1.4 ENVIRONMENTAL ANALYSIS PROCESS

The BLM, as authorized by the Council for Environmental Quality (CEQ) and the National Environmental Policy Act (NEPA) directives, analyzes actions involving federal leases as to their impact on the human environment (40 CFR, Parts 1500-1508). The analysis is to determine whether approval of the action would result in unnecessary or undue degradation of the land. The analysis uses an accepted process for evaluating and disclosing the potential environmental consequences of the proposed action and alternatives.

The BLM, Rock Springs District, Rock Springs, Wyoming, is the lead agency responsible for preparation of this EIS. The BOR is a cooperating agency. The evaluation of the proposed action and alternatives was developed through interdisciplinary field review with representatives from the Operators, the BLM, and the project interdisciplinary team (IDT).

This EIS is *not* a decision document. It records the approved process used to analyze the environmental effects of the proposed natural gas production project and alternatives. The decision regarding the project will be documented in a Record of Decision (ROD) signed by the BLM Wyoming State Director. The BLM's decision will relate primarily to federal lands administered by the BLM. Decisions by other jurisdictions to issue approvals related to this proposal may be aided by the disclosure of impacts available in this analysis.

This EIS will guide the implementation of a selected alternative and will facilitate preparation of additional environmental analyses within the analysis area and adjacent lands. This EIS is *not* the final environmental review upon which approval of all actions in the Moxa analysis area will be based. Site-specific environmental analyses will be required prior to surface disturbance for each drill site and associated roads and pipelines located on public lands.

1.5 RELATIONSHIP TO POLICIES, PLANS, AND PROGRAMS

1.5.1 Conformance With Land Use Plan

The document that directs management of federal lands within the Moxa analysis area is the ROD for the Kemmerer RMP (USDI-BLM 1986).

1.5.1.1 Kemmerer Resource Management Plan EIS and Record of Decision

Management objectives and actions applicable to the proposed action and alternatives within the KRA are as follows:

Oil and gas leasing will continue throughout the KRA. As oil and gas leases expire, or otherwise terminate, the areas will, in most cases, continue to be re-offered for lease.

All public lands within the resource area have been reviewed as suitable for oil and gas leasing and development subject to certain stipulations. Resource management and protection stipulations will be developed and implemented on an "as needed" basis to prevent undue adverse impacts to other resource values.

The proposed natural gas production project is in conformance with management objectives provided in the Kemmerer RMP.

1.5.1.2 Amoco Production Company Moxa Arch Natural Gas Production Project EA/DR

The MAEA/DR (USDI-BLM 1991a) authorized the Operators to drill 72 infield wells within the existing Moxa analysis area Arch Field of 312 wells. The MAEA/DR conditioned approval upon protective measures set forth in the Amoco Proposed Action and mitigation and monitoring measures specified in the MAEA/DR. Development plans on federal lands in the Expanded Moxa Arch area would include the same mitigation measures and any others identified through the expanded area environmental analysis.

1.5.1.3 Supplemental EA

The Supplemental EA (USDI-BLM 1992a) was prepared to analyze the potential impacts of downspacing natural gas development within a 35,000-acre area (14 percent) of the Moxa analysis area. The downspacing approved by the WOGCC was influenced by the federal tax incentive in the Crude Oil Windfall Tax Act of 1980, which expired in December 1992. The downspacing was from a well spacing of 320 acres (two wells per section) to a well spacing of 160 acres (four wells per section). The Supplemental EA conditioned approval upon protective measures set forth for the Amoco Proposed Action and mitigation and monitoring measures specified in the 1991 EA/DR. The Expanded Moxa Arch Area development plans would include the same mitigation measures and any others identified through the expanded areas environmental analysis.

1.5.2 Standard Mitigation Guidelines for Surface-Disturbing Activities

Wyoming BLM Standard Mitigation Guidelines for Surface Disturbing Activities (Appendix A) are incorporated into the oil and gas leases within the Moxa analysis area. The purposes of these guidelines are to: 1) reserve, for the BLM, the right to modify the operations of surface and other human presence disturbance activities for environmental protection and 2) inform a potential lessee of the requirements that must be met when using BLM-administered public lands. Standard mitigation guidelines applicable to the proposed natural gas production operations within the analysis area are presented in Appendix A.

1.6 AUTHORIZING ACTIONS

The proposed federal, state, county, and local actions required to implement the Expanded Moxa Arch Area Natural Gas Development project are listed in Table 1-4.

1.7 ISSUES AND CONCERNS

Public issues and comments regarding this project were solicited for incorporation into this EIS through the scoping process. A Scoping Statement that described the possible actions/alternatives to be analyzed was prepared and submitted to the public on December 13, 1993. The statement identified preliminary land and resource management issues, concerns, and opportunities, and outlined timing needs for public involvement. Environmental and social issues of local importance associated with natural gas production were identified and follow below.

1) Disruption of livestock management operations (primarily herding) and potential for loss of suitable range forage within the analysis area resulting from additional field development activities.

2) Cumulative impacts of natural gas in-field development relative to other land and resource activities in the area, both on-going and proposed.

3) Potential impacts to the air quality of the area resulting from dust and emissions created by construction and natural gas production activities.

4) Existing road and gas pipeline concerns:

   - Increased traffic and associated impacts on existing county, state, and BLM roads.

Table 1-4. Federal, State, and County Authorizing Actions.

Agency	Nature of Action
Department of Interior	
Bureau of Land Management (Rock Springs District)	Approves Application for Permit to Drill (APD) and Sundry Notices, approves disposal of produced water, approves well plugging and well abandonment. Gives Unit Area Agreement approval. Approves gas venting or flaring during testing. Approves disposal of produced water. Grants ROWs to Area Operators/lease holders for gas field development actions on BLM surface outside federal unit boundaries and to third party actions (i.e., non-unit operator or non-lease holder) both within and outside of the unit boundary. Reviews inventories of and impacts to, cultural resources affected by undertakings and consults with State Historic Preservation Office (SHPO) and Advisory Council on Historic Preservation (ACHP).
Bureau of Reclamation	Grants ROWs on BOR-managed lands
U.S. Fish and Wildlife Service	Reviews impacts on federally listed or proposes for listing any threatened or endangered species of fish, wildlife, and plants.
Department of the Army	
U.S. Army Corps of Engineers	Issues (Section 404) permit(s) for placement of dredged or fill material in or excavation of waters of the U.S. and their adjacent wetlands.
Wyoming Department of Environmental Quality	
Water Quality Division	Administers Storm Water Pollution Prevention Plan (SWPPP). Approves Surface Discharge. Approves sewage treatment facilities (groundwater pollution control permit). Approves culinary water supply for resident camp. Approves wastewater disposal.
Wyoming State Engineer's Office	
	Issues permits to appropriate groundwater and surface water. Issues temporary water rights for construction permits to appropriate surface water.
Wyoming State Historic Preservation Office	
	Provides consultation concerning inventory of, and impacts to, cultural resources.

Table 1-4. Federal, State, and County Authorizing Actions, Continued.

Agency	Nature of Action
Wyoming Oil and Gas Commission	
	Acts as primary authority for drilling on state and privately held mineral resources. Holds authority to allow or prohibit flaring or venting of gas. Regulates drilling and plugging of wells. Issues Aquifer Exemption Permit. Approves directional drilling. Administers rules and regulations governing drilling units. Issues permits to drill and use of blowout prevention. Grants gas injection well permits.
Sweetwater, Lincoln, and Uinta Counties	
	Issues Encroachment Permits. Issues oil and gas location permits for all drilling locations. Grants small wastewater system permits, where applicable. Issues driveway access permits where new roads intersect with county roads. Provides road use agreements and/or oversize trip permits when traffic on county road exceeds established size and weight limits or where the potential for excessive road damage exists. Issues construction and conditional use permits for all new structures. Administers zoning changes where applicable. Handles filing fees.

- Utilization of existing road and pipeline corridors rather than construction of new ones (i.e., cumulative site disturbance effects resulting from additional road and pipeline construction within an existing corridor).

5) Potential impact to mineral and paleontologic resources at all disturbed sites associated with natural gas production operations.

6) Concern that well casing corrosion and leakage could cause degradation of mineral resources through contamination.

7) Potential impacts to the quality of surface and groundwater resources and wetland areas within the analysis area and adjacent lands.

8) Concerns that well drilling, completion, and operation will cause mixing of different quality groundwater, resulting in groundwater quality degradation.

9) Concerns that corrosion of well casings will result in leakage into groundwater and water quality degradation.

10) Concerns that standard operating procedures in regard to well completion are not sufficient to prevent leakage and groundwater quality degradation.

11) The potential for increased erosion resulting from access roads, pipeline, and drill site construction activities, primarily on sensitive soils (e.g., those which are highly erosive such as red soils, calcareous soils, sand dunes, or sandy soils).

12) Reclamation of disturbed areas and control of noxious weed invasions following reclamation.

13) Possible adverse impacts to wildlife in the analysis area/adjacent lands, including the following:

    - Potential impacts to wildlife habitats within the analysis area and adjacent lands for sage grouse, raptors, prairie dogs, big game winter range (primarily pronghorn antelope), and non-game wildlife species.

    - Potential impact to special status plant and animal species and communities.

14) Potential impacts associated with noise due to construction activities and natural gas production operations.

15) Potential impacts to known and unknown cultural and historic values within the analysis area.

16) Socioeconomic impacts to local communities resulting from project implementation, subsequent increased demand on local facilities and services, and additional strain on the existing housing market.

1.8 OPPORTUNITIES

Opportunities that may arise from the Expanded Moxa Arch Natural Gas Development project include the following:

1) The Operators' continuing development of proven natural gas reserves.

2) The Operators' exploring new drilling and production techniques within the Moxa analysis area that would allow for development of leases currently having marginal profitability.

   These techniques could include the drilling of multiple wells from a single well pad, thus reducing overall surface disturbance within the Moxa analysis area.

3) Potential economic benefits to communities surrounding the Moxa analysis area by providing jobs and an increase in the local tax base.

4) The opportunity to develop a domestic energy source that decreases dependence on foreign sources.

5) A clean-burning energy resource that could supplement or replace some existing energy sources that are more harmful to the environment.

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CHAPTER 2

PROPOSED ACTION AND ALTERNATIVES

CHAPTER 2

PROPOSED ACTION AND ALTERNATIVES

2.0 SUMMARY

The Moxa Operators have proposed to drill and develop approximately 1,325 well locations over the next ten-year planning period (1995-2005) in addition to existing drilling and production operations within the Expanded Moxa Arch Natural Gas Development (Moxa) area.

This proposal would provide for development of natural gas fields within the Moxa analysis area. The precise number of additional wells, locations of the wells, and timing of drilling would be directed by the success of development drilling and production technology, and economic considerations such as the cost of development of leases with marginal profitability. As a part of the Proposed Action, several experimental drilling and production techniques may be used by the Moxa Operators in order to reduce environmental impacts and drilling and production costs, and in order to develop marginal areas/properties. These techniques, when utilized, could include horizontal drilling and one pad/multi-well directional drilling. A description of these techniques is provided in the Plan of Operations discussed in the following sections.

This chapter describes the Moxa Operators' Proposed Action, one action alternative (Alternative A), and the No Action alternative (Alternative B) analyzed in this environmental impact statement (EIS). Alternative A contains a lesser degree of development than the Proposed Action, and Alternative B would allow existing production activities to continue but no further natural gas development (drilling) would be authorized on federal lands unless it were within the scope of existing environmental analysis. However additional development could occur under Alternative B on private and State lands. In summary, the Proposed Action would entail development of 1,325 well sites (610 well sites within the proven production area and 715 well sites from the flank area); Alternative A would entail development of 795 well sites (610 well sites within the proven productive area and 185 well sites within the flank area); and Alternative B, No Action, would allow operation of existing development and currently authorized development as granted on a case-by-case basis by the Bureau of Land Management (BLM) consistent with the scope of existing environmental analysis (USDI-BLM 1991a) or by the Wyoming Oil and Gas Conservation Commission (WOGCC) for development on private or State lands.

2.1 ALTERNATIVE SELECTION PROCESS

The Proposed Action of drilling and developing 1,325 well locations in addition to existing drilling and production operations was determined by summarizing drilling plans projected by the Moxa Operators over the next ten-year planning period. Drilling estimations were based on 1) present WOGCC-approved spacing within the individual fields and 2) reasonably foreseeable spacing and drilling projections into areas within the Moxa analysis area where the majority of planned activity would occur.

For planning purposes, the Moxa analysis area was divided into two areas; a current productive area of "proven" gas reserves, and a "flank" area where production exists but reserves are not proven (Exhibit 2-1). Also shown are existing drills in the analysis area. The current productive or "proven" area is predominantly spaced at four wells per section. The flank area is generally unspaced, but WOGCC Rule 302 would allow drilling of four wells per section in the unspaced areas.

Recent and current drilling activity has focused largely on the proven productive area. The Moxa Operators reasonably expect that this area would be developed at an average level of four wells per section within the ten-year planning period. Development at this level would result in the drilling of approximately 610 additional wells in the proven productive area (Table 2-1).

Based on the current understanding of the natural gas reservoir characteristics (i.e., geology, flow data from existing producers, expected recovery factors, and economics), a maximum development level of four wells per section is deemed appropriate for most of the Moxa analysis area. Some areas with below-average recovery of gas reserves may justify well densities of five to eight wells per section. These areas are presently not defined; increasing density beyond four wells per section would depend not only on reservoir and recovery considerations but also on gas prices, well costs, and economics. The Moxa Operators presently feel that this option is not likely on a field-wide basis.

Table 2-1. Ten-Year Drilling Estimate and Projected Drilling Activity within the Moxa Analysis Area.

Ten Year Estimate					
Action Area	# of Square Mile Sections	# of Well Pads per Section	# of Existing Well Pads	# of Additional Proposed Well Pads	Total # of Existing and Proposed Well Pads
Proposed Action					
Existing proven productive area	386.0	4	934	610	1,544
Flank Area	369.0	2	23	715	738
TOTAL	**755.0**	**-**	**957**	**1,325**	**2,282**
Alternative A					
Existing proven production area	386.0	4	934	610	1,544
Flank Area	369.0	1 well per 2 sections	23	185	208
TOTAL	**755.0**	**-**	**957**	**795**	**1,752**

Future development is expected to extend the production limits of the field into the flank area but at a slower pace than has been seen in the proven productive area.

Flank area development is expected to reach no more than an average density of two wells per section within the ten-year planning period. It is generally understood by the Moxa Operators that the potential for natural gas production decreases down-structure over the flanks of the Moxa Arch. Also, as well productivity declines, higher gas prices are required to support the drilling of lower production rate wells. Since the industry outlook for the gas market is one of stable, slow growth, with gas prices increasing only a few percentage points per year into the foreseeable future, it is expected that flank development would proceed at a similar pace. A drop in gas prices in the next few years could result in minimal flank development, while an increase would accelerate development. In the most aggressive scenario, an average development density of no more than four wells per section would be expected in the flank area within the ten-year planning period, or 715 wells. A minimum development scenario in the flank area would be an average development density of no fewer than one well per section on 50 percent of the flank area, or 185 wells.

Table 2-1 summarizes the ten-year drilling estimates within the Moxa analysis area, and Exhibit 2-1 shows the production areas used in determining the proposed drilling and production program.

Based on the planning information provided by the Moxa Operators, this EIS addresses the Proposed Action and two alternatives.

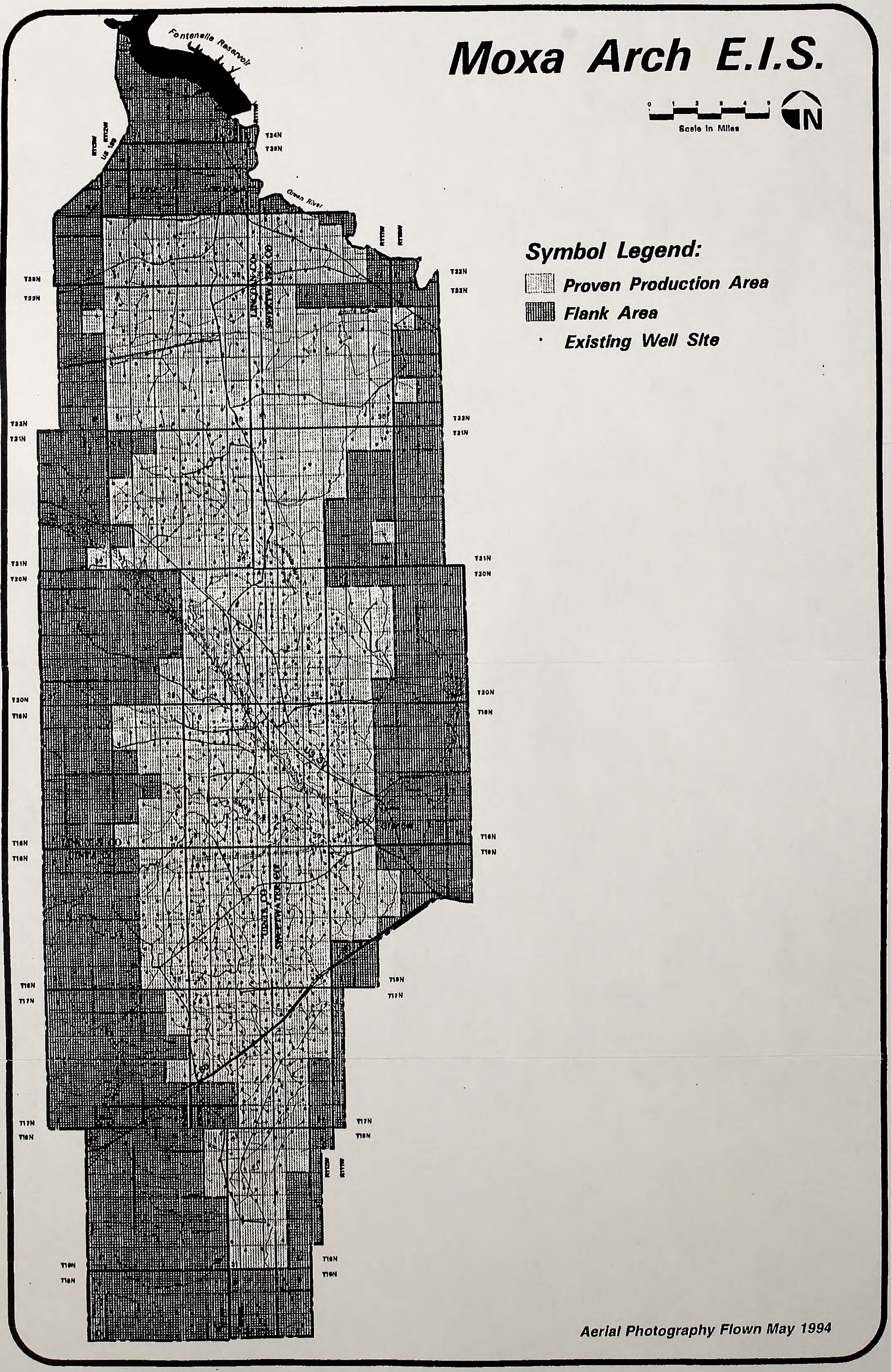

Exhibit 2-1. Existing Drill Sites and Production Areas within the Moxa Analysis Area (Proven Productive and Flank Area).

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- Proposed Action - The Moxa Operators would drill and develop 1,325 well sites within the Moxa analysis area in addition to existing operations (Optimum Development Scenario [maximum development]).
- Alternative A - The Moxa Operators would drill and develop 795 well sites within the Moxa analysis area in addition to existing operations (Minimum Development Scenario).
- Alternative B (No Action) - This alternative implies that the BLM would allow the level of natural gas production activities on federal lands in the Moxa analysis area as authorized by the MAEA (USDI-BLM 1991a) but would disallow development beyond the MAEA. Application for Permits to Drill (APDs) and right-of-way (ROW) actions would be granted by the BLM on a case-by-case basis. Additional oil/gas development could occur on State and private lands within the analysis area under APDs approved by the WOGCC.

In summary, the Proposed Action would provide an Optimum Development Scenario of 1,325 additional production well sites (610 well sites within the proven production area and 715 well sites from the flank area) and related facilities. This scenario would allow Moxa Operators to develop natural gas reserves at current WOGCC-approved spacing authorizations. This proposed development level also should provide consideration of topographic and environmental limitations within the Moxa analysis area (e.g., restricted accessibility resulting from terrain limitations, areas of crucial wildlife habitat with seasonal restrictions, etc.).

Alternative A would provide a Minimum Development Scenario of 795 additional production well sites (610 well sites within the proven productive area and 185 well sites within the flank area) with related roads, pipelines, and production facilities. Both development scenarios would be completed over the ten-year planning period.

2.2 PROPOSED ACTION - DRILL AND DEVELOP AN ADDITIONAL 1,325 WELL SITES WITHIN THE EXPANDED MOXA ARCH NATURAL GAS PRODUCTION AREA IN ADDITION TO EXISTING OPERATIONS.

Specific components of the Expanded Moxa Arch Natural Gas Development program are summarized in the following sections. Additional site-specific environmental analysis and resource information would be contained in the individual well APD and/or ROW application when submitted to the BLM.

2.2.1 Preconstruction Planning and Site Layout

The Moxa Operators would follow the procedures outlined below to gain approval for the proposed activity on *public lands* within the Moxa analysis area. Development activities proposed on fee and State of Wyoming surface lands would be approved by the WOGCC. The WOGCC permitting procedures require filing an APD with the WOGCC and obtaining a ROW from the surface owner.

- Prior to the start of construction activities, the Moxa Operators would submit a Notice of Staking (NOS)/APD/Sundry Notice/ROW Application to the BLM with a map showing the specific location of the proposed activity, (e.g., individual drill sites, pipeline corridors, access roads, or other facilities). The applicant, BLM, and other interested parties (e.g., grazing permittee) would conduct an on-site evaluation during which specific construction measures, erosion control needs, design specifications, resource concerns, etc. would be identified and likely conditions of approval specified. Following the on-site evaluation, the applicant would file the application which would include site-specific construction plans where necessary to describe the proposed development (i.e., drilling plans with casing/cementing program; surface use plan with detailed engineering design, reclamation plans, etc.).

- The proposed facility would be staked by the applicant and inspected by an interdisciplinary team and/or an official from the BLM to ensure consistency with plans in the APD/Sundry Notice/ROW Application.

- More detailed construction plans, when required by the BLM for proposed development in areas of steep slopes, historic trails, riparian areas, floodplains, etc., would be submitted to the BLM by the applicant. The plans would address concerns that may exist concerning construction standards, required mitigation, etc. Negotiation of these plans between the proponent and BLM, if necessary to resolve differences, would be based on field inspection findings and would take place either during or after the BLM on-site inspection.

- The applicant would revise the APD/Sundry Notice/ROW Application as necessary per negotiations with the BLM. The BLM would then approve the specific proposal and attach the Conditions of Approval to the permit. The applicant then has one year within which to commence the proposed activity.

- Prior to approval, the applicant must have cleared the proposed well site, access road, pipeline corridor, or other sites, for cultural values, special status plants and animals, paleontological values, nesting raptors, sage grouse, etc. If found, appropriate mitigation would be applied.

Following is a general discussion of construction techniques proposed to be used by the Moxa Operators on public lands. These construction techniques would be applicable to drill site, pipeline, and access road proposals within the Moxa analysis area and may vary between the individual Operators.

2.2.2 Construction and Drilling Phase

2.2.2.1 Well Pad Design and Construction

The traditional single-well pad design has been utilized in the Moxa analysis area in the past almost exclusively and would continue to be the predominant drill site design utilized under the Proposed Action.

The traditional well pad, constructed from native materials located at the site, has occupied an approximate area of 3.4 to 3.67 acres (approximately 400 feet by 400 feet) as shown in Exhibit 2-2. The actual well pad size depends on terrain limitations and area of cut-and-fill at each individual drill site location. Actual well pad size is shown on the individual well site APD. The well pad is designed so that construction materials balance (i.e., soil materials taken from cuts would be about the same quantity as that needed for fill to construct a level pad), while attempting to minimize the total disturbed area. All available topsoil suitable for reclamation (up to 12 inches) is stripped from the well pad area and stored adjacent to the well pad. This storage site is to be designated on the well pad design in the APD prior to start of actual well pad construction. Cut-and-fill slopes are designed, if deemed necessary, in a manner that allows for retention of topsoil during reclamation and subsequent re-establishment of vegetation. Total disturbance associated with drill site construction (drill pad, cut-and-fill slopes, and ancillary disturbance) ranges from four to six acres and generally averages five acres.

Construction of well pad and related facilities usually requires approximately three to five days to complete, depending on site and terrain limitations. After topsoil stripping operations are complete, construction of the well pad begins. Construction practices involve use of standard earthmoving equipment.

Components of the well pad include construction of a reserve pit to temporarily store drilling fluids, cuttings, and water produced during drilling, as well as a flare pit. Exhibit 2-2 shows the approximate layout of the drill pad and drilling-related facilities. In non-critical areas and when a fresh water based mud system is being used, an unlined earthen reserve pit would be utilized.

Earthen reserve pits would be used only after evaluation of the pit location for distance to surface waters, depth to useable ground water, soil type and permeability, and after evaluation of the fluids which would likely be retained in the pit.

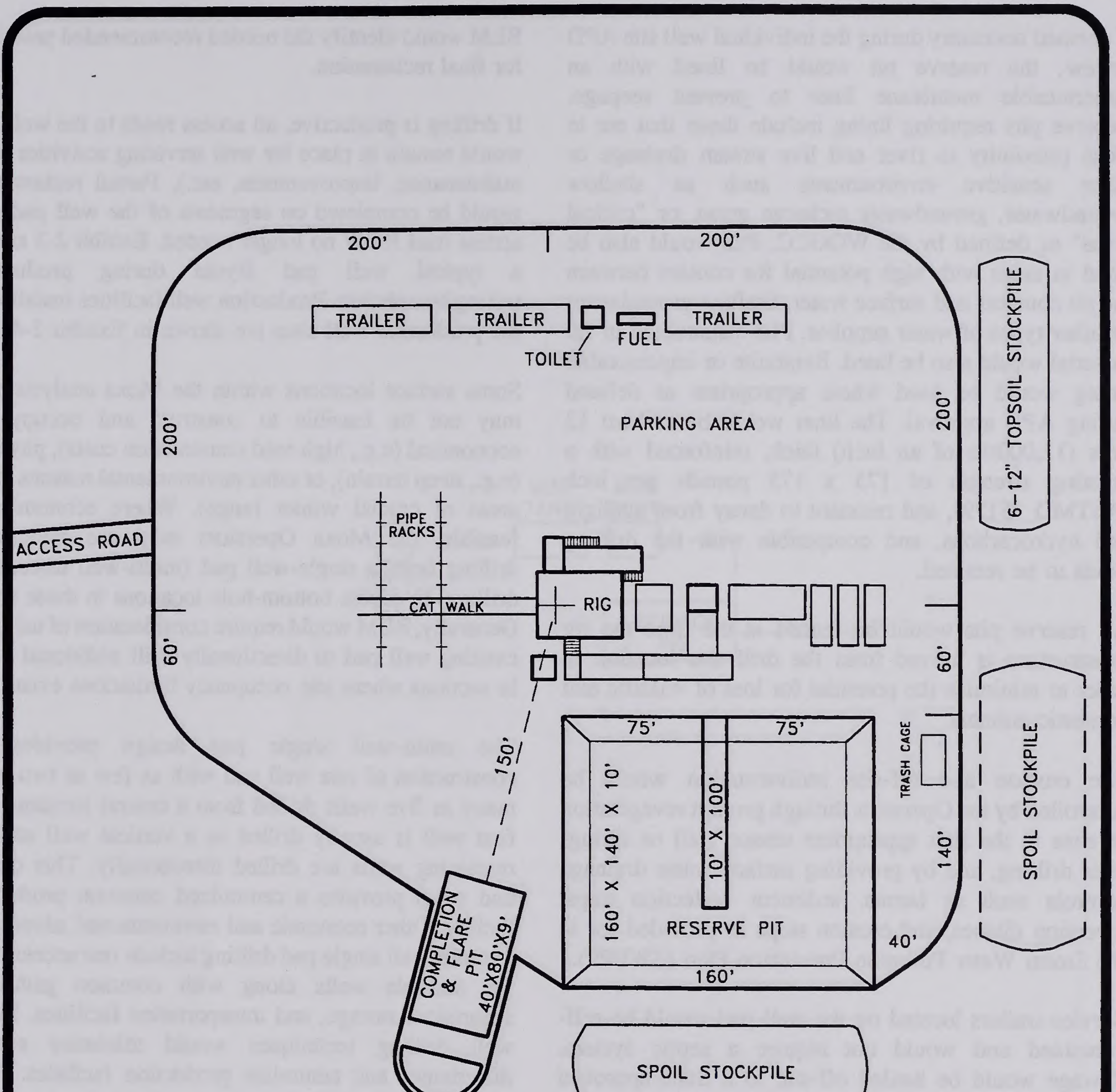


Exhibit 2-2. Typical Well Pad Layout During Drilling Operations.

If deemed necessary during the individual well site APD review, the reserve pit would be lined with an impermeable membrane liner to prevent seepage. Reserve pits requiring lining include those that are in close proximity to river and live stream drainage or other sensitive environments such as shallow groundwater, groundwater recharge areas, or "critical areas" as defined by the WOGCC. Pits would also be lined in areas with high potential for contact between the pit contents and surface water, shallow groundwater or other types of water supplies. Pits constructed in fill material would also be lined. Bentonite or impermeable lining would be used where appropriate as defined during APD approval. The liner would be at least 12 mils (12,000ths of an inch) thick, reinforced with a bursting strength of 175 x 175 pounds per inch (ASTMD 75179), and resistant to decay from sunlight and hydrocarbons, and compatible with the drilling fluids to be retained.

All reserve pits would be fenced at the time the rig substructure is moved from the drill site location in order to minimize the potential for loss of wildlife and domestic animals.

Site erosion and off-site sedimentation would be controlled by the Operators through prompt revegetation of sites in the first appropriate season (fall or spring) after drilling, and by providing surface water drainage controls such as berms, sediment collection traps, diversion ditches, and erosion stops as provided for in the Storm Water Pollution Prevention Plan (SWPPP).

Service trailers located on the well pad would be self-contained and would not require a septic system. Sewage would be hauled off-site to a State-approved disposal site approximately every two weeks, depending on the amount of use the septic system receives.

In the event drilling is non-productive, all disturbed areas, including the well site and new access road, would be reclaimed to the landform that existed prior to construction. Reclamation and site stabilization techniques would be applied as specified in the APD Surface Use Plan or the ROW Plan of Development (POD). Guidelines for reclaiming disturbed areas associated with drill site, access road, pipeline, and facility construction are shown in Appendix B. The BLM would identify the needed recommended practices for final reclamation.

If drilling is productive, all access roads to the well site would remain in place for well servicing activities (i.e., maintenance, improvements, etc.). Partial reclamation would be completed on segments of the well pad and access road ROW no longer needed. Exhibit 2-3 shows a typical well pad layout during production testing/completion. Production well facilities installed at the production well sites are shown in Exhibit 2-4.

Some surface locations within the Moxa analysis area may not be feasible to construct and occupy for economical (e.g., high road construction costs), physical (e.g., steep terrain), or other environmental reasons (e.g., areas of crucial winter range). Where economically feasible, the Moxa Operators may use directional drilling from a single-well pad (multi-well directional drilling) to access bottom-hole locations in these areas. Generally, BLM would require consideration of using an existing well pad to directionally drill additional wells in sections where site occupancy limitations exist.

The multi-well single pad design provides for construction of one well pad with as few as two or as many as five wells drilled from a central location. The first well is usually drilled as a vertical well and the remaining wells are drilled directionally. This design and setup provides a centralized common production facility. Other economic and environmental advantages to multi-well single pad drilling include one access route for multiple wells along with common gathering, separation, storage, and transportation facilities. Multi-well drilling techniques would minimize surface disturbance and centralize production facilities. Also, with multi-well drilling, several wells can be serviced at one time with one trip, thus minimizing vehicular traffic, dust control, and disturbance to wildlife. Techniques and equipment for constructing a multi-well directional drill pad would be similar to those utilized in constructing a single-well traditional well pad. An example of a multi-well pad is shown in Exhibit 2-5. Standard vertical drilling and directional drilling techniques are discussed in Section 2.2.2.4.

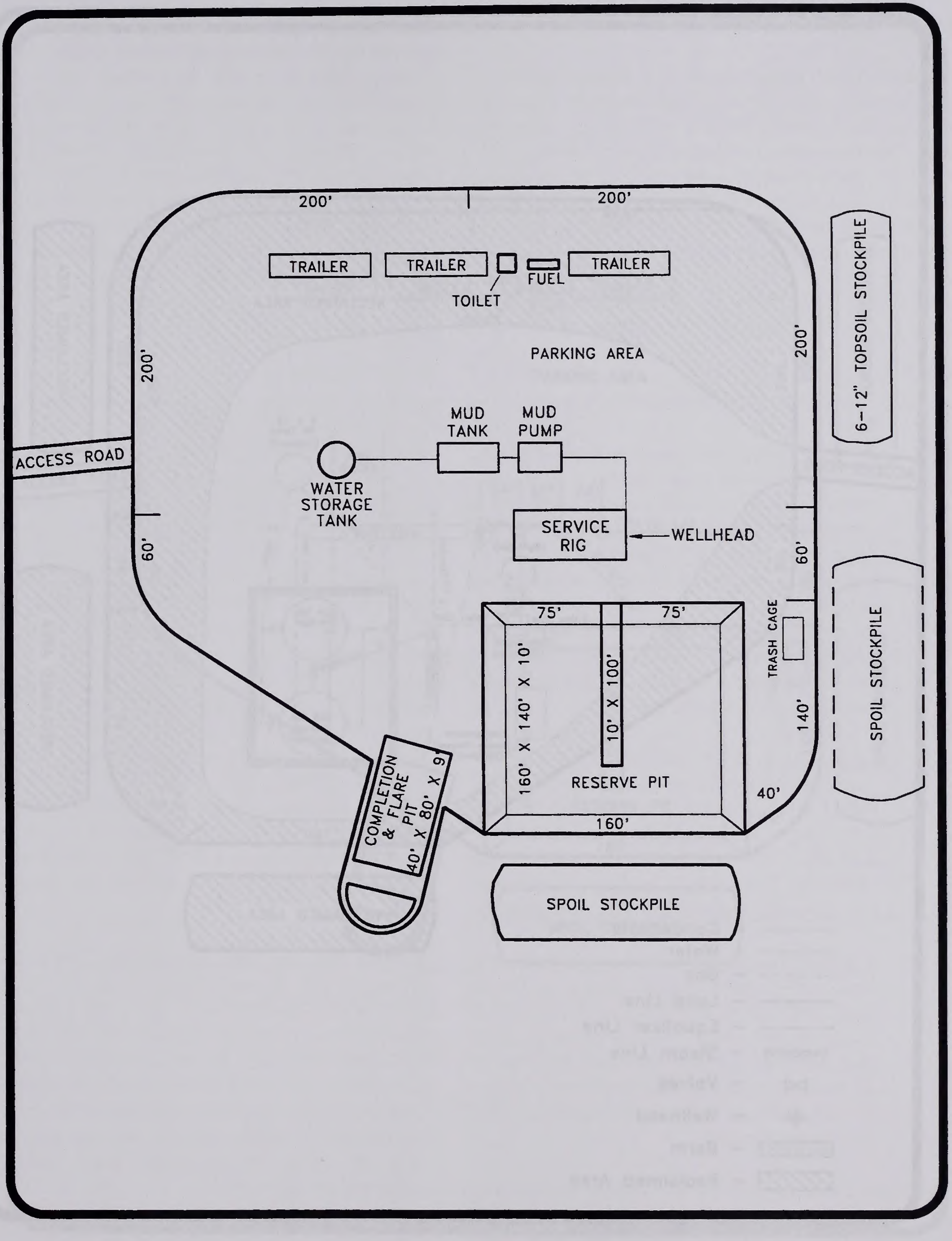


Exhibit 2-3. Typical Well Pad Layout During Production Testing and Completion.

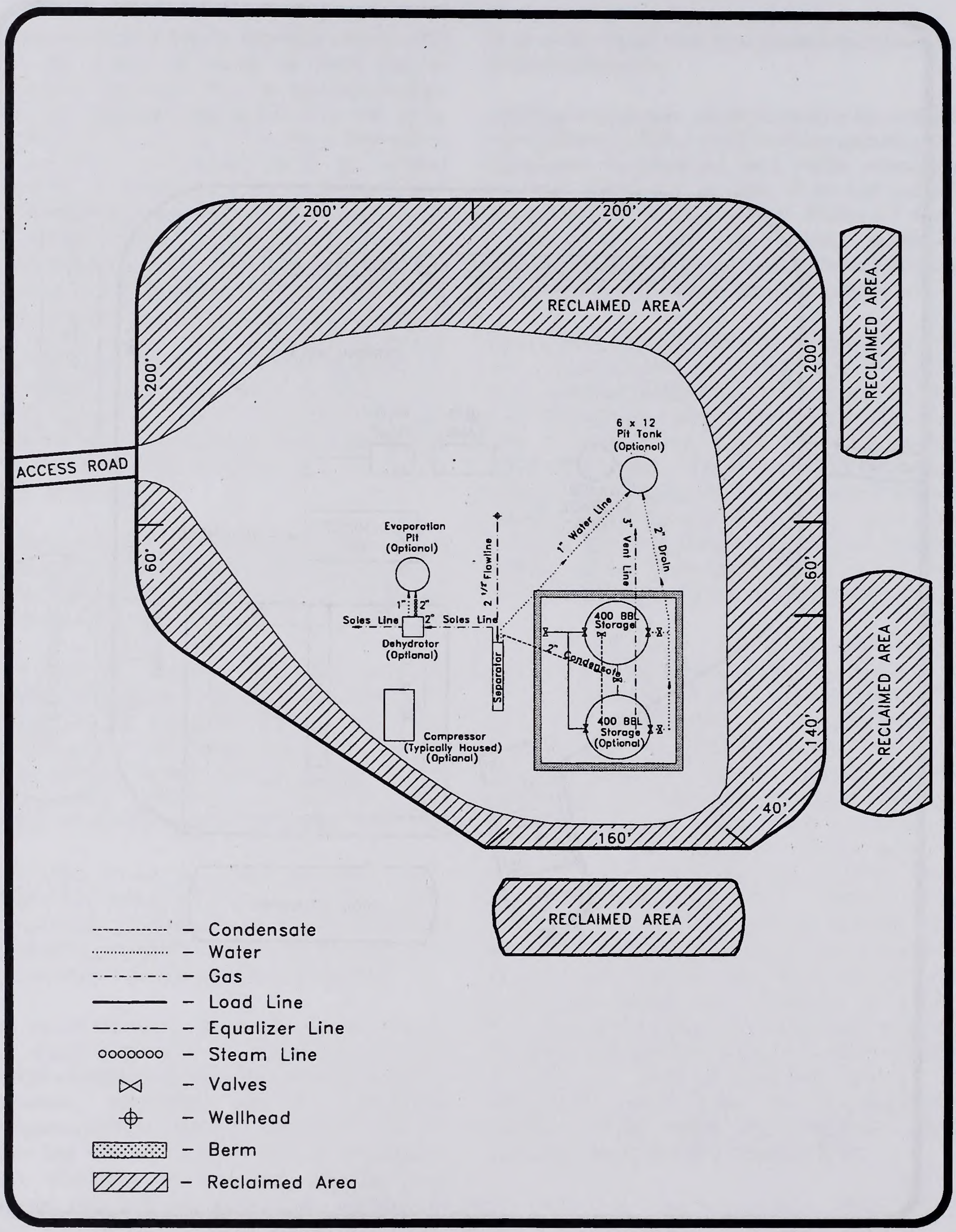


Exhibit 2-4. Typical Well Pad Diagram with Product Equipment and Partial Reclamation.

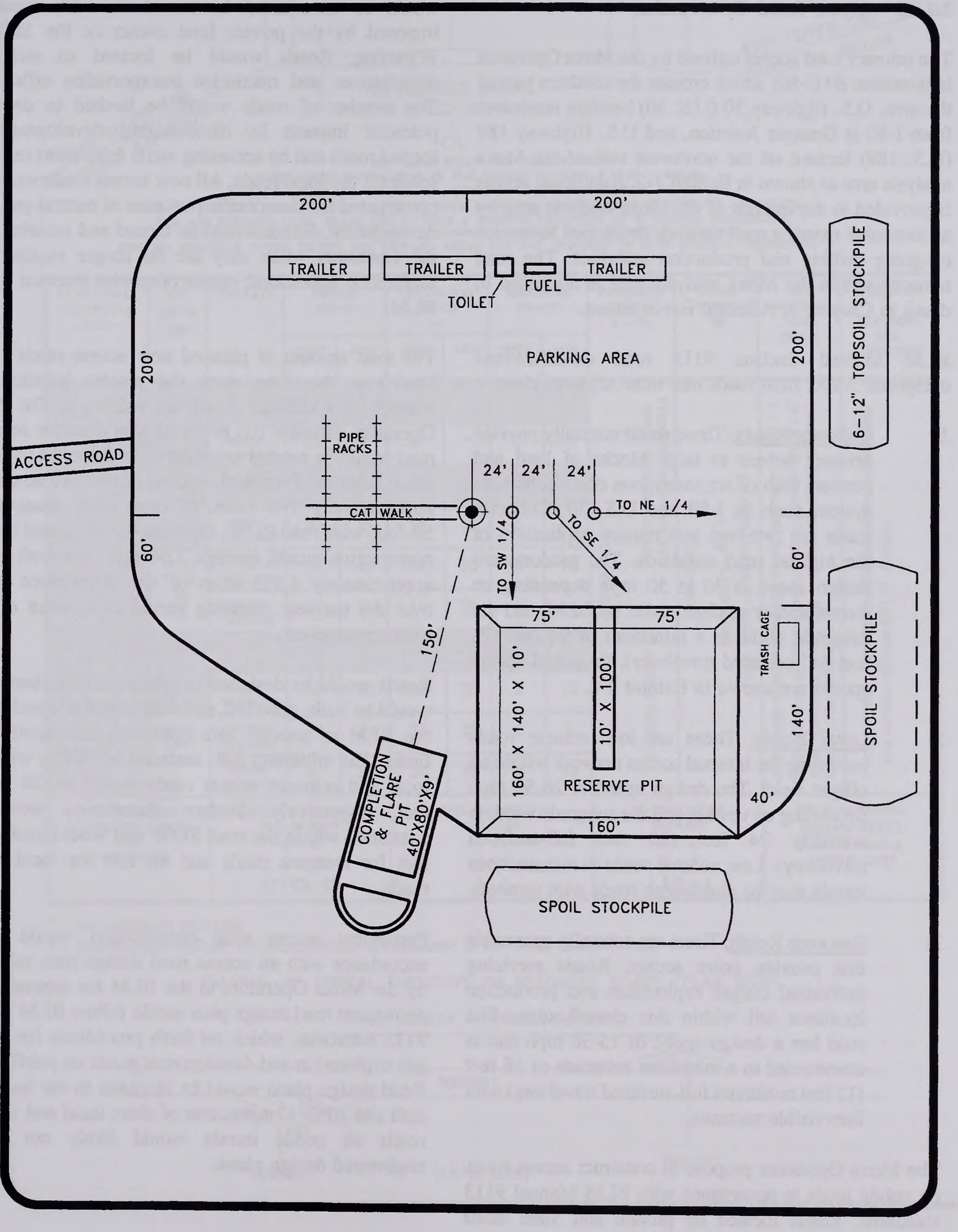


Exhibit 2-5. Typical Drawing of a Multi-well Pad Showing Location and Spacing of Multiple Wells.

2.2.2.2 Access Road Construction

The primary road access utilized by the Moxa Operators is Interstate 80 (I-80) which crosses the southern part of the area, U.S. Highway 30 (U.S. 30) heading northwest from I-80 at Granger Junction, and U.S. Highway 189 (U.S. 189) located on the northwest side of the Moxa analysis area as shown in Exhibit 1-2. Additional access is provided to the interior of the Moxa analysis area by an extensive existing road network developed to service on-going drilling and production activities. The road network within the Moxa analysis area is discussed in detail in Chapter 3, Affected Environment.

BLM Manual Section 9113 road classifications categorize Moxa field roads into three separate classes:

1) Collector Roads. These roads normally provide primary access to large blocks of land and connect with or are extensions of a public road system such as I-80 and U.S. 30. Collector roads are two-lane and require application of the highest road standards. The predominant design speed is 30 to 50 mph depending on terrain and/or as determined by BLM, and the subgrade width is a minimum of 24 feet (20 feet full-surfaced travelway). Proposed design speeds are shown in Exhibit 2-6.

2) Local Roads. These are low volume roads providing the internal access network within an oil/gas field. The design speed is 20-50 mph depending on terrain, and the subgrade width is normally 24 feet (20 feet full-surfaced travelway). Low volume roads in mountainous terrain may be single-lane roads with turnouts.

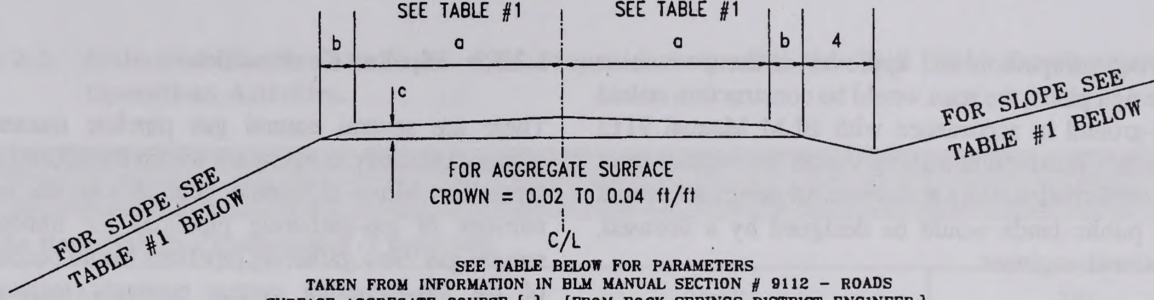
3) Resource Roads. These are normally spur roads that provide point access. Roads servicing individual oil/gas exploration and production locations fall within this classification. The road has a design speed of 15-30 mph and is constructed to a minimum subgrade of 16 feet (12 feet minimum full-surfaced travelway) with intervisible turnouts.

The Moxa Operators propose to construct access roads on public lands in accordance with BLM Manual 9113 standards. Roads located on private and State lands would be constructed in accordance with standards imposed by the private land owner or the State of Wyoming. Roads would be located to minimize disturbances and maximize transportation efficiency. The number of roads would be limited to decrease potential impacts by discouraging development of looped roads and by accessing wells from short resource roads off the local roads. All new access roads would be constructed for the specific purposes of natural gas field development. Roads would be closed and reclaimed by the Operators when they are no longer required for production operations, unless otherwise directed by the BLM.

The total amount of planned new access roads is not known at this time since the precise location and number of additional wells are unknown. The Moxa Operators estimate 0.6 miles of new local or resource road would be needed to access each proposed new well site. Under the Proposed Action, this would amount to approximately 795 miles of new road. Assuming a 50-foot-wide road ROW, the disturbance caused by road construction would average 3.64 acres per well site or approximately 4,823 acres of site disturbance spread over the ten-year planning period as a result of new road construction.

Roads would be designed to minimize disturbance and would be built, graveled, and maintained as specified by the BLM to provide safe operating conditions at all times. The minimum full- surfaced travelway width for local and resource access roads would be 20 and 12 feet, respectively. Surface disturbance would be contained within the road ROW and would average 40 feet for resource roads and 48 feet for local access roads.

Permanent access road construction would be in accordance with an access road design plan submitted by the Moxa Operators to the BLM for approval. The permanent road design plan would follow BLM Manual 9113 standards, which set forth procedures for oil and gas exploration and development roads on public lands. Road design plans would be included in the individual drill site APD. Construction of short local and resource roads on gentle terrain would likely not require engineered design plans.


SEE TABLE #1
SEE TABLE #1
b
a
a
b
4
c
FOR SLOPE SEE TABLE #1 BELOW
FOR SLOPE SEE TABLE #1 BELOW
FOR AGGREGATE SURFACE CROWN = 0.02 TO 0.04 ft/ft
C/L

SEE TABLE BELOW FOR PARAMETERS
TAKEN FROM INFORMATION IN BLM MANUAL SECTION # 9112 – ROADS
SURFACE AGGREGATE COURSE [c] : [FROM ROCK SPRINGS DISTRICT ENGINEER.]
NEW AND EXISTING COLLECTOR ROADS ARE TO HAVE A MINIMUM THICKNESS OF 6" SURFACE AGGREGATE.
NEW AND EXISTING LOCAL ROADS ARE TO HAVE A MINIMUM THICKNESS OF 6" SURACE AGGREAGATE;
NEW RESOURCE ROADS ARE TO HAVE A MINIMUM THICNESS OF 4" SURFACE AGGREGATE.
EXISTING RESOURCE ROADS, EXCEPT FOR PROBLEM AREAS ARE NOT REQUIRED TO HAVE SURFACE AGGREGATE.

FUNCTIONAL CLASSIFICATION	EST. 20 YR ADT	TERRAIN	DESIGN SPEED		TRAVELWAY WIDTH (a)		MAXIMUM GRADE		SUBGRADE WIDTH (a + 2b)	TAPER WIDTH (b)	CUT SECTION SIDE DITCH	VERTICAL & HORIZONTAL ALIGNMENT
			PREF	MIN	PREF	MIN	PREF	MIN				
RESOURCE[1]	LESS THAN 20	LEVEL & ROLLING	30	*	14	*	8	10	TRAVELWAY WIDTH + TWICE THE TAPER WIDTH OF SURFACING MATERIALS (NORMALLY)	TAPER WIDTH = SURFACE DEPTH X 4 TAPER SLOPE = 4 : 1 (NORMALLY)	SLOPE FROM EDGE OF SUBGRADE TO BOTTOM OF DITCH = 4 : 1. DISTANCE FROM EDGE OF SUBGRADE TO BOTTOM OF DITCH = 4'. FROM BOTTOM OF DITCH, SIDE OF DITCH SLOPES UPWARD THE SAME AS SIDE CUT SLOPE.	FOR VERTICAL & HORIZONTAL ALIGNMENT PARAMETERS SEE BLM MANUAL SECTION #9113 - ROADS.
		MOUNTAINOUS	15	*	14	*	8	10				
LOCAL	LESS THAN 100	LEVEL & ROLLING	40	30	20	20	6	10				
		MOUNTAINOUS	20	15	14	12	8	15				
	MORE THAN 75	LEVEL & ROLLING	50	40	24	20	6	10				
		MOUNTAINOUS	30	15	24	20	8	14				
COLLECTOR	50-100	LEVEL & ROLLING	50	30	24	20	6	8				
		MOUNTAINOUS	30	20	20	20	8	12				
	MORE THAN 100	LEVEL & ROLLING	50	40	24	20	6	8				
		MOUNTAINOUS	30	20	24	20	8	12				

RECOMMENDED EARTH SIDE SLOPES FOR BLM ROADS:	HEIGHT OF CUT OR FILL IN FEET	LEVEL OR ROLLING TERRAIN	MOUNTAINOUS TERRAIN	SEE BLM MANUAL SECTION #9113 FOR ADDITIONAL INFORMATION
	0 - 4	4 : 1	3 : 1	
	4 - 10	3 : 1	2 : 1	
	OVER 10	2 : 1	1 1/2 : 1	

* - No guidelines provided.
1 - Shaded items indicate the predominant circumstance in the Moxa analysis area.

DIAGRAM OF TYPICAL TURNOUTS ON RESOURCE ROADS (PLAN VIEW)

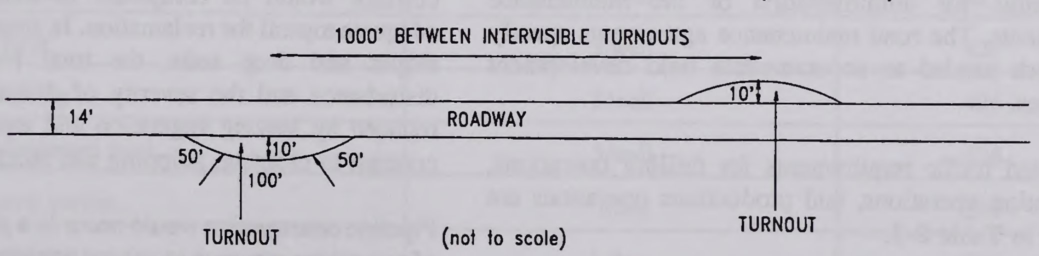


Exhibit 2-6. Typical Roadway Cross-Section with Width Specifications.

Following completion and approval of the permanent road design plans, the road would be construction staked on-the-ground in accordance with BLM Manual 9113 standards. Construction staking would be in place prior to any surface disturbing activities. All permanent roads across public lands would be designed by a licensed, professional engineer.

Construction equipment and techniques utilized by the Moxa Operators would be standard (e.g., crown-and-ditch method.) A typical roadway cross-section with width specifications for use in the Moxa analysis area is shown in Exhibit 2-6. Resource roads to producing well sites would be graveled within one year following successful drilling, or within one year from when the well goes to production. Surfacing and base course materials would be obtained from existing, operational gravel pits. Roads would be built and maintained to provide year-round access. Respreading of topsoil and windrowed vegetation to the sideslopes of the newly constructed access roads and revegetation would begin the first fall following the well going to production. The resource road to an unproductive well site would be reclaimed upon abandonment of the well using stockpiled topsoil and a seed mixture specified in the approved reclamation plan. Reclamation measures would be implemented the first fall after well abandonment.

Transportation planning has been initiated by some Operators within the Moxa analysis area; road maintenance agreements between the primary Operators are in effect. The agreements are being implemented under the direction of the BLM, Kemmerer Resource Area. The agreements provide for maintenance of existing roads in accordance with BLM Manual 9113 standards. Also, while all parties operating in a given area within the Moxa analysis area are responsible for road maintenance, the lead operator (the operator with the greater number of wells) in an area will be responsible for administration of the maintenance agreements. The road maintenance agreements specify the work needed to accommodate field development activities.

Estimated traffic requirements for drilling operations, completion operations, and productions operations are shown in Table 2-2.

2.2.2.3 Pipeline Construction

There are several natural gas pipeline transmission systems currently in operation within the Moxa analysis area. The Moxa Operators plan to use the existing network of gas-gathering pipelines for transport of natural gas. New gathering pipelines would become part of the gas-gathering system currently managed by Williams Field Services, Mountain Gas Resources, Questar Pipeline Company, and Overland Trail Transmission Company. New gas gathering pipelines would be three or four inches in diameter. distance from a new well to the existing gathering system would be between 0.5 and 1.5 miles. The Moxa Operators estimate an average of 1.1 miles of new pipeline would be needed to connect new wells with the existing pipeline system. For the Proposed Action, this would result in approximately 1,458 miles of new gathering pipeline construction (assuming all new wells are productive). The maximum width of the pipeline ROW and disturbance area would be 50 feet, and the disturbance associated with pipeline construction would average 6.67 acres per well site. This results in approximately 8,838 acres of additional site disturbance resulting from pipeline construction spread over the ten-year planning period.

The ROW would be placed adjacent to existing pipelines or roads where possible. A typical schematic of pipeline installation procedures is shown in Exhibit 2-7.

The actual pipeline location would be surveyed and staked prior to start of any construction activities. When required by the BLM, the company installing the pipeline would submit detailed design plans for pipeline(s) planned on slopes 25 percent or greater. The pipeline corridor would be cleared of heavy brush prior to any activities. Stripping of topsoil from the pipeline corridor would be completed in those areas having adequate topsoil for reclamation. In some areas of gentle slopes and deep soils, the total potential area of disturbance and the severity of disturbance could be reduced by leaving vegetation and topsoil in place, in contrast to clearing, stripping and stockpiling.

Pipeline construction would occur in a planned sequence of operations common to natural gas pipeline installation specifications and would take place along a corridor of

Table 2-2. Estimated Traffic Associated with Proposed Action-Related Well Field Development and Operations Activities.

Type of Activity	Frequency	Trips/Year
Access Road/Well Pad Construction (5 days/well)		
Haul truck for dozer	2/well	284
Haul truck for grader	2/well	284
Haul truck for backhoe	2/well	284
Gravel truck	480/mi of road (assume 0.61 mi/well)	41,578
Drilling Activities (25 days/well)		
Rig transport vehicles (3 days/well)	13/well	1,846
Rig crews	3/day	10,650
Rig Mechanics	1/week	507
Operating Co. supervisor	1/day	3,550
Tool pusher	1/day	3,550
Mud logger	2/day	7,100
Fuel truck	3/week	1,521
Mud truck	2/well	284
Mud engineers	3/day	3,550
Loggers, engineer's truck	9/well	142
Drill bit deliveries	2/week	1,014
Completion (two days/well)		
Casing haulers	9/well	1,278
Cementers, pump truck	3/well	436
Cementers, cement truck	6/well	852
Cementers, engineer's pickup	6/well	852
Casing crew truck	3/well	426
Completion unit rig	3/well	426
Completion equipment truck	3/well	426
Completion crew pickup	1/day	284
Completion pusher	1/day	284

Table 2-2. Estimated Traffic Associated with Proposed Action-Related Well Field Development and Operations Activities, Continued.

Type of Activity	Frequency	Trips/Year
Testing (22 days)		
Tubing truck	2/well	284
Service tools	2/week	284
Perforators, logging truck	2/well	284
Perforators engineer's truck	2/well	284
Anchor, installation truck	1/well	142
Anchor testing truck	1/well	142
Fracing, tank trucking	12/well	1,278
Fracing pump trucks	8/well	1,136
Fracing blender	2/well	284
Fracing chemical trucks	1/well	142
Fracing, sand trucks	12/well	1,704
Fracing, engineer's car	8/well	284
Other fracing accessory vehicles	9/well	1,278
Operating Co. supervisor	1/well	142
Miscellaneous Supplies	4/week	1,785
Pumping/tank battery	5/well	710
Roustabout crew	1/day	3,124
Welders	3/well	426
Water truck	20/well	2,840
Operation and Maintenance		
Well Workover (five days every ten years)		
Service unit	8/well	142
Service unit equipment truck	1/well	142
Service unit crew pickup	2/day	1,420
Pusher truck	1/day	710
Operating Co. supervisor pickup	1/day	710

Table 2-2. Estimated Traffic Associated with Proposed Action-Related Well Field Development and Operations Activities, Continued.

Type of Activity	Frequency	Trips/Year
Operations (life of project)		
Production foreman	1/2 weeks	3,692
Pumper	1/well/day	51,120
Condensate tank truck	1/12 wells/week	615
Reclamation (seven days/well)		
Haul truck for dozer	2/well	284
Haul truck for grader	2/well	284
Haul truck for seeder	2/well	284
Estimated Increase in Annual Trips	**TOTAL**	**158,390**
Estimated Increase in AADT	**TOTAL/DAY**	**528**

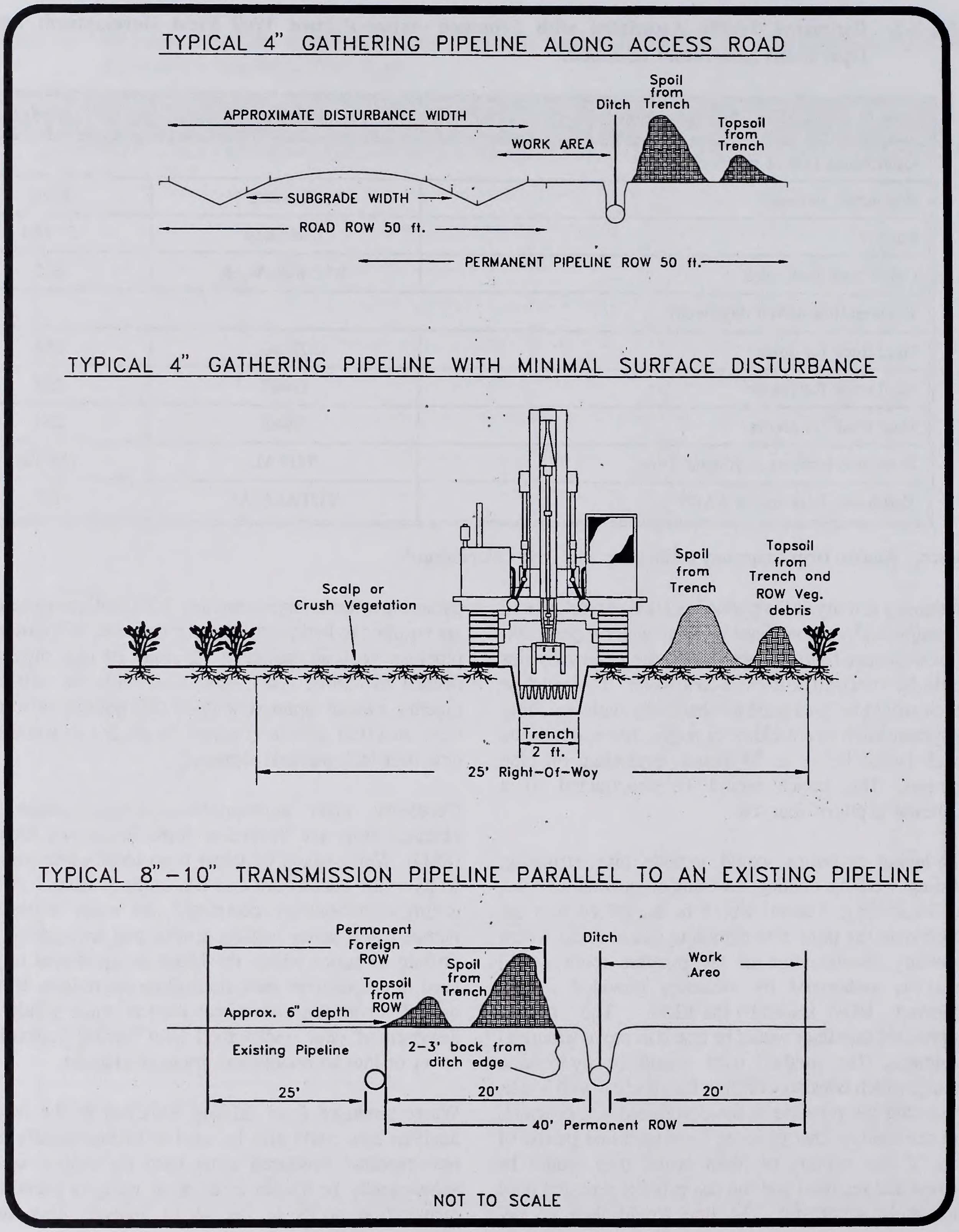
Source: Amoco (trip frequency estimates); PIC (trip calculations).

continuous activity. All pipeline installation work would be completed by a contractor working under supervision of the designated Moxa Operator. Construction activities would be confined to the 50-foot ROW. The pipeline trench would be excavated mechanically with trenching equipment such as a backhoe or auger. The width of the trench would be 18 to 20 inches, depending on pipe diameter. The trench would be constructed to a minimum depth of four feet.

Pipe-laying activities would include pipe stringing, bending, welding, coating, lowering of pipeline sections, and backfilling. Subsoil would be backfilled into the trench over the pipe. Site regrading would occur where necessary. Reclamation of the pipeline route would occur as authorized by measures provided in the approved ROW issued by the BLM. The newly-constructed pipelines would be tested to prove structural soundness. The method used would be hydrostatic testing, which consists of filling the pipeline with water, pressuring the pipeline to the designated test pressure, and maintaining that pressure for a specified period of time. If any rupture or leaks occur, they would be located and repaired and the test process repeated until completely successful. The line would then be de-watered and dried to prepare it for final tie-in to the gas gathering system. Approximately 2,700 gallons of water are required to hydrostatically test one mile of four-inch pipeline. With an estimated 1.1 miles of new pipeline needed to connect each new well with the existing pipeline system, approximately 3,000 gallons of water (less than 0.01 acre-feet) would be needed to test each new four-inch pipeline segment.

Necessary water appropriation permits would be obtained from the Wyoming State Engineer's Office (SEO). Water would be taken from local water source wells or the Hams Fork and Blacks Fork Rivers. After testing operations are completed, the water would be pumped into water hauling trucks and transported to drilling locations within the Moxa analysis area to be used in conjunction with the drilling operations. If not needed for drilling operations, the test water would be disposed of onto undisturbed land having vegetative cover or into an established drainage channel.

Water produced from drilling activities in the Moxa analysis area could also be used to hydrostatically test new pipeline. Produced water used for testing would subsequently be hauled to disposal wells or permitted evaporation ponds in the Moxa analysis area after testing was completed.



TYPICAL 4" GATHERING PIPELINE ALONG ACCESS ROAD

TYPICAL 4" GATHERING PIPELINE WITH MINIMAL SURFACE DISTURBANCE

Topsoil from Trench and ROW Veg. debris
Spoil from Trench
Scalp or Crush Vegetation
Trench
2 ft.
25' Right-Of-Way

TYPICAL 8"-10" TRANSMISSION PIPELINE PARALLEL TO AN EXISTING PIPELINE

NOT TO SCALE

Exhibit 2-7. Typical Schematic of Pipeline Installation.

2.2.2.4 Drilling Operations

Following construction of the access road and drill pad, the drill rig would be moved to the pad and erected on-site. Each drilling operation would require transport of approximately 60 truckloads of drilling-related equipment and materials to facilitate the drilling operation. This number includes transportation of the drill rig, drill pipe, drilling fluid products, and related support equipment but does not include the truck traffic required for resupplying the operation (e.g., fuel). Additional traffic would be variable, depending on the phases of the drilling operation, but should not include more than two or three vehicles per day per drill site throughout the drilling operation (Table 2-2).

Total rig-up activities and installation of ancillary facilities would take three days to complete. The approximate planned drilling depth is 11,300 feet for a well drilled into the Frontier Formation, and 12,300 feet for a well drilled into the Dakota Formation (the two primary gas producing formations in the Moxa analysis area). A Frontier well takes approximately 13 days to drill and a Dakota well approximately 18 days, barring any major drilling problems.

Water, for drilling and service trailer use, would be obtained from State of Wyoming approved locations on the Blacks Fork, Hams Fork and Green River, with additional water coming from water wells drilled on private surface. Water requirements for drilling average approximately 10,000 barrels (bbls) per well (420,000 gallons or approximately 1.29 acre-feet). The Moxa Operators intend to use freshwater-based mud for the majority of their drilling operations.

Virtually all the gas wells in the Moxa analysis area to date were drilled by the traditional vertical method. Vertical rotary drilling within the Moxa analysis area has been developed into a highly efficient process for drilling and completing traditional oil and gas wells.

As previously discussed, some surface locations within the Moxa analysis area may not be feasible to occupy, either for economical (e.g., high road construction costs), for physical (e.g., steep terrain), or for other environmental reasons (e.g., areas of crucial winter range). A drilling method the Moxa Operators may use to access bottom-hole locations in these areas is directional drilling from a single-well pad (multi-well, directional drilling).

The multi-well single pad design provides for construction of one well pad with as few as two or as many as five wells drilled from a central location. This design and setup provides for one access route for multiple wells along with common gathering, separation, storage, and transportation facilities. Use of multi-well directional drilling techniques would be contingent on economic considerations such as the cost to develop leases having marginal profitability. Because of these unknowns, this EIS assumes that only one well per pad would be constructed.

Directional drilling requires special drilling tools and procedures to change the direction of the well bore from vertical to directional and possibly horizontal in order to penetrate targets that cannot be reached by conventional vertical drilling methods. Advancement in directional drilling technology makes it possible to reach bottom holes 2,000 or more feet from the rig. Certain geologic features can limit this (e.g., faults, structural dips, etc.). A typical directional drilling schematic showing directional drilling profile well path, target, and limits is shown in Exhibit 2-8.

Another drilling procedure that may possibly be utilized in the Moxa analysis area is horizontal drilling. This drilling technique has been successfully utilized in other gas development programs in Wyoming to improve the productivity of existing marginal wells, and may have application in the Moxa analysis area in developed fields exhibiting marginal profitability.

Horizontal drilling involves drilling a curved section from the bottom of a vertical hole, followed by drilling horizontally into the productive formation. Long, horizontally drilled sections may increase oil and gas flows. Exhibit 2-9 shows a cross-sectional view of horizontal drilling. A schematic showing drilling and completion phases of a horizontal well is shown in Exhibit 2-10.

2.2.2.5 Estimated Employment Requirements

The estimated employment requirements for the drilling, completion/testing, and producing well services are

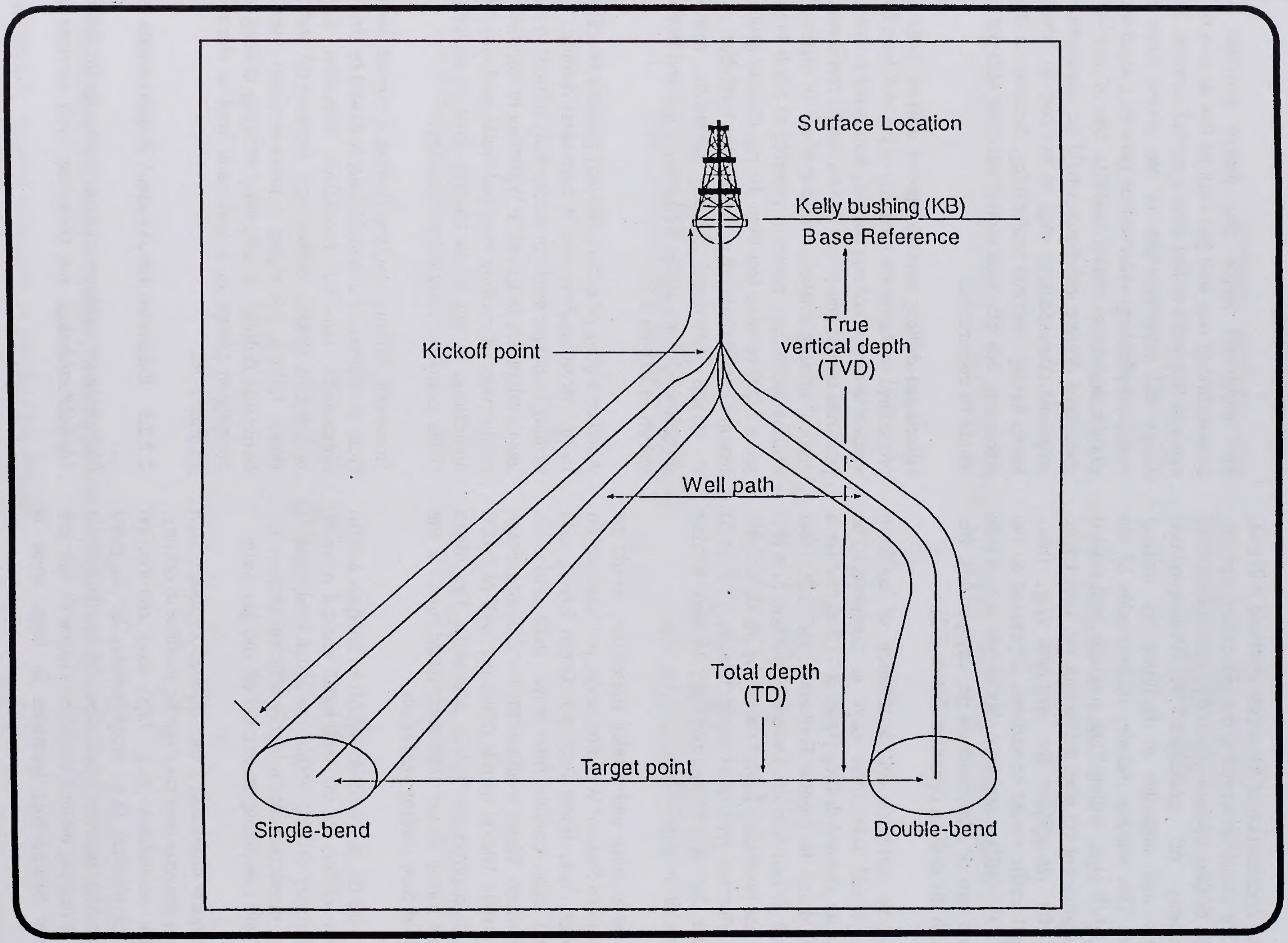


Exhibit 2-8. Directional Drilling Profile Well Path, Target, and Limits.

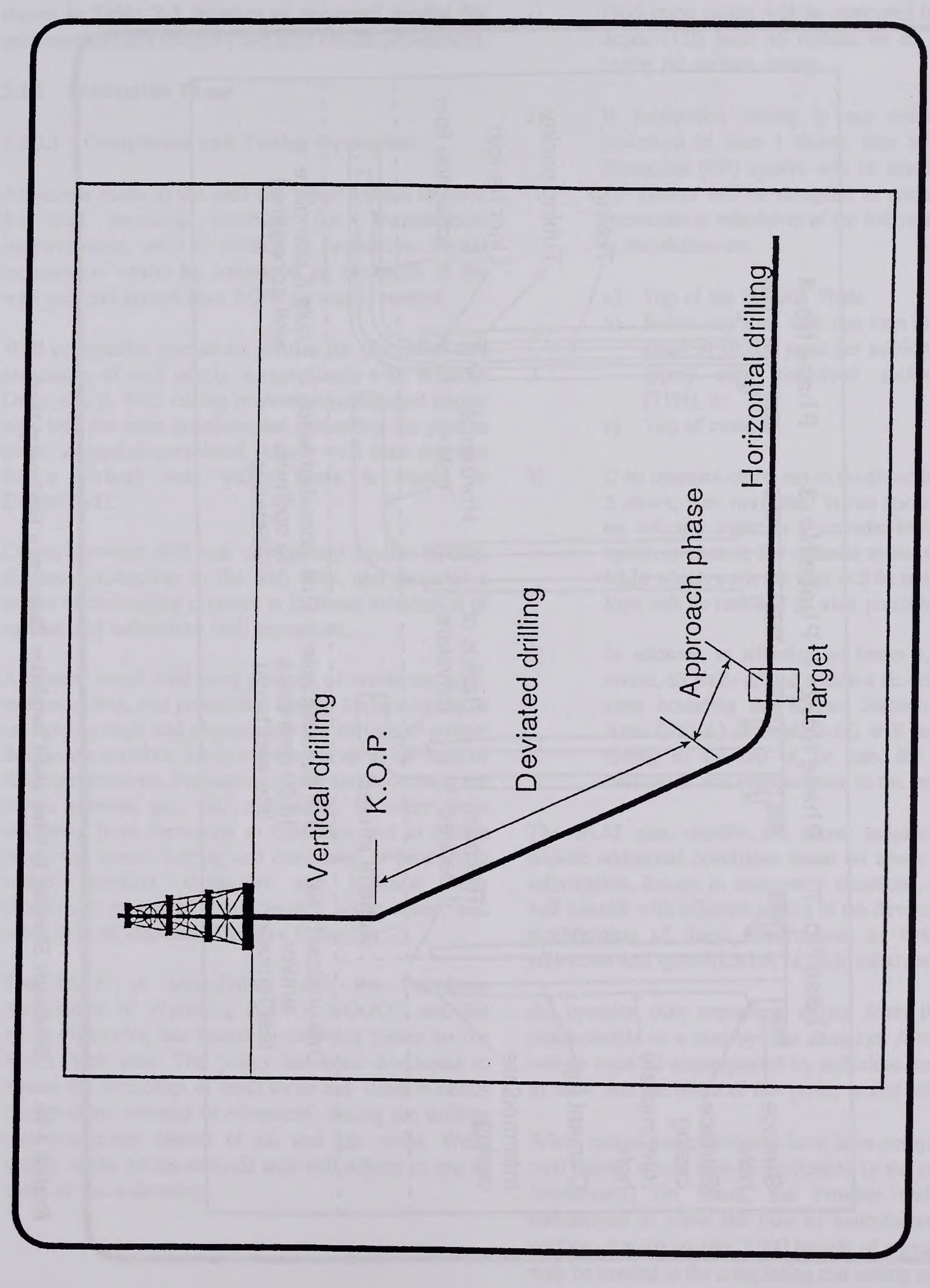


Exhibit 2-9. Cross-sectional View of Horizontal Drilling.

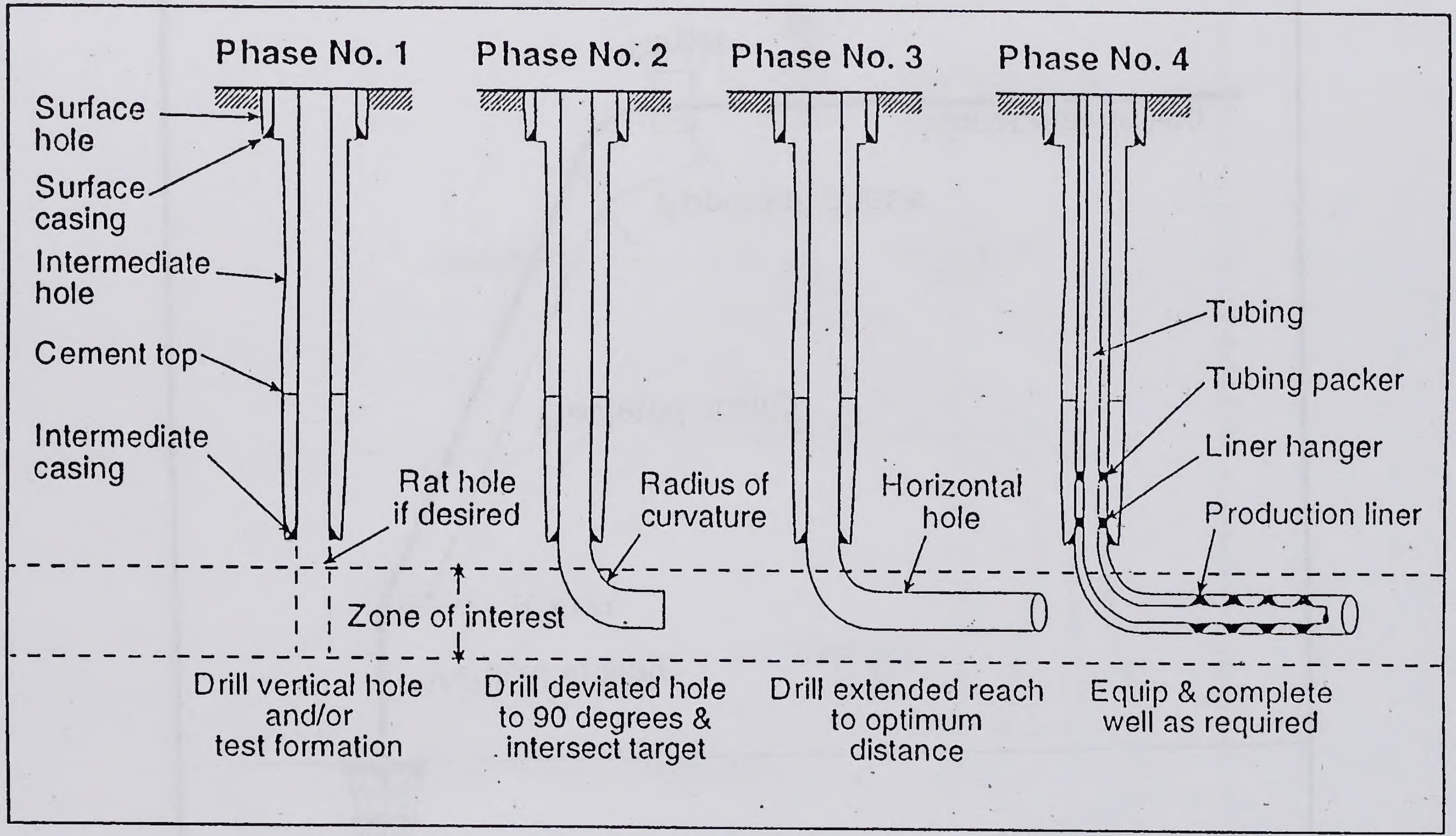


Exhibit 2-10. **Schematic Showing Drilling and Completion Phases of a Horizontal Well.**

shown in Table 2-3 (number of personnel needed for each employment category and their on-site attendance).

2.2.3 Production Phase

2.2.3.1 Completion and Testing Operations

All access roads to the well site would remain in place for well servicing activities (i.e., maintenance, improvements, etc.) if drilling is productive. Partial reclamation would be completed on segments of the well pad and access road ROW no longer needed.

Well completion operations involve the placement and cementing of well tubing in compliance with Onshore Order No. 2. Well casing involves running steel casing pipe into the open borehole and cementing the pipe in place. A typical completed (cased) well bore diagram for a vertical well within Moxa is shown in Exhibit 2-11.

Casing prevents drill hole cave-in and aquifer mixing, confines production to the well bore, and provides a means of controlling pressure to facilitate installation of surface and subsurface well equipment.

A typical cased well bore consists of conductor pipe, surface casing, and production casing. Surface casing is set deep enough and cemented to the surface to protect freshwater aquifers. Surface casing is set at the start of drilling operations. Production casing and cementing are set to prevent gas, oil, condensate, or water from migrating from formation to formation and to isolate producing zones. Setting and cementing of production casing provides separation and isolation from abnormally pressured zones, usable water zones, and other mineral deposits (Onshore Order No. 2).

The BLM, in consultation with the Petroleum Association of Wyoming (PAW), WOGCC, and the Moxa Operators, has issued a cementing policy for the Moxa Arch area. The policy has been developed to ensure the protection of fresh water and other minerals (i.e., sodium mineral development) during the drilling and production phases of oil and gas wells. Wells drilled in the Moxa analysis area will adhere to one or more of the following:

1) Production casing will be cemented from total depth (TD) back to surface or to 250 feet inside the surface casing.

2) If production casing is not cemented as described in Item 1 above, then a Cathodic Protection (CP) system will be installed. The CP system will be designed to ensure casing protection to whichever of the following depths is the shallowest:

   a) Top of the Hilliard Shale,
   b) Below any zone with less than or equal to 10,000 parts per million (ppm) total dissolved solids (TDS), or
   c) Top of cement.

3) If an operator elects not to do either Items 1 or 2 above, they may elect to run corrosion logs on selected wells on a periodic basis. If this option is chosen, the operator must inform the BLM which wells the logs will be run on, what logs will be run, and at what periodic rate.

4) In addition to adhering to Items 1, 2, or 3 above, all wells drilled within a six-mile buffer zone bounding the Known Sodium Leasing Area (KSLA) (Exhibit 2-12) will set surface casing to the top of, or into, the Wasatch Formation and cement back to the surface.

The BLM may modify the above requirements or impose additional conditions based on newly acquired information. Except in emergency situations, the BLM will consult with affected parties in the development or modification of these requirements as well as the collection and quantification of such information.

An operator may request a waiver from the above requirements on a case-by-case situation. A request for waiver must be accompanied by sufficient justification to show that the intent of this policy is and will be met.

When casing and cementing have been completed, the well casing would then be perforated in the productive formation(s) (in Moxa, the Frontier and Dakota formations) to allow the flow of hydrocarbons to the surface. Approximately 2,500 barrels of water per well may be needed in the completing and testing operations.

Table 2-3. Estimated Employment Requirements, Expanded Moxa Arch Natural Gas Production Project.

Employment Category	Number of Personnel	Expected Period of On-Site Occurrence
Access Road and Well Pad Construction (5 days/well)	3	Commute daily
Rig Transport and Rig-Up Operations (3 days/well)	20	Commute daily
Drilling (25 days/well)		
Drilling foreman	1	Reside in Granger
Tool pusher	1	Reside on-site
Mud logger	1	Reside on-site
Morning tour rig crew	5	Commute daily
Daylight tour rig crew	5	Commute daily
Evening tour rig crew	5	Commute daily
Mud engineer	1	Commute daily
Drilling engineer	1	Commute once every six months
Salesman, Service Companies	--	Irregular commute
TOTAL	**20**	
Completion and Testing (25 days/well)		
Casing crew	5	Commute two times
Cementing crew	5	Commute two times
Completion foreman	1	Commute daily during completion
Tool pusher	4	Commute daily
Rig crew	4	Commute daily
Stimulation crew	6-20	Irregular commute
Wireline crew	3	Commute one time

Table 2-3. Estimated Employment Requirements, Expanded Moxa Arch Natural Gas Production Project, Continued.

Employment Category	Number of Personnel	Expected Period of On-Site Occurrence
Completion and Testing (25 days/well)		
Flow test crew	1	Commute 10 times
Roustabout	2	Commute daily
Salesman, Service Companies	--	Irregular commute
TOTAL	**29-43**	
Well Operations		
Well Workover (every ten years)		
Workover foreman	1	Commute daily
Rig pusher	1	Commute daily
Rig crew	3	Commute daily
Wireline crew	3	Irregular commute
Service crew	3	Irregular commute
Roustabout	3	Irregular commute
TOTAL	**14**	
Operations (life of project)		
Production foreman	1	Irregular commute
Pumper	1	Commute seven days/week
Condensate hauler	1	Commute five days/week
TOTAL	**3**	
Reclamation (seven days/well)		
Reclamation crew	3	Irregular commute

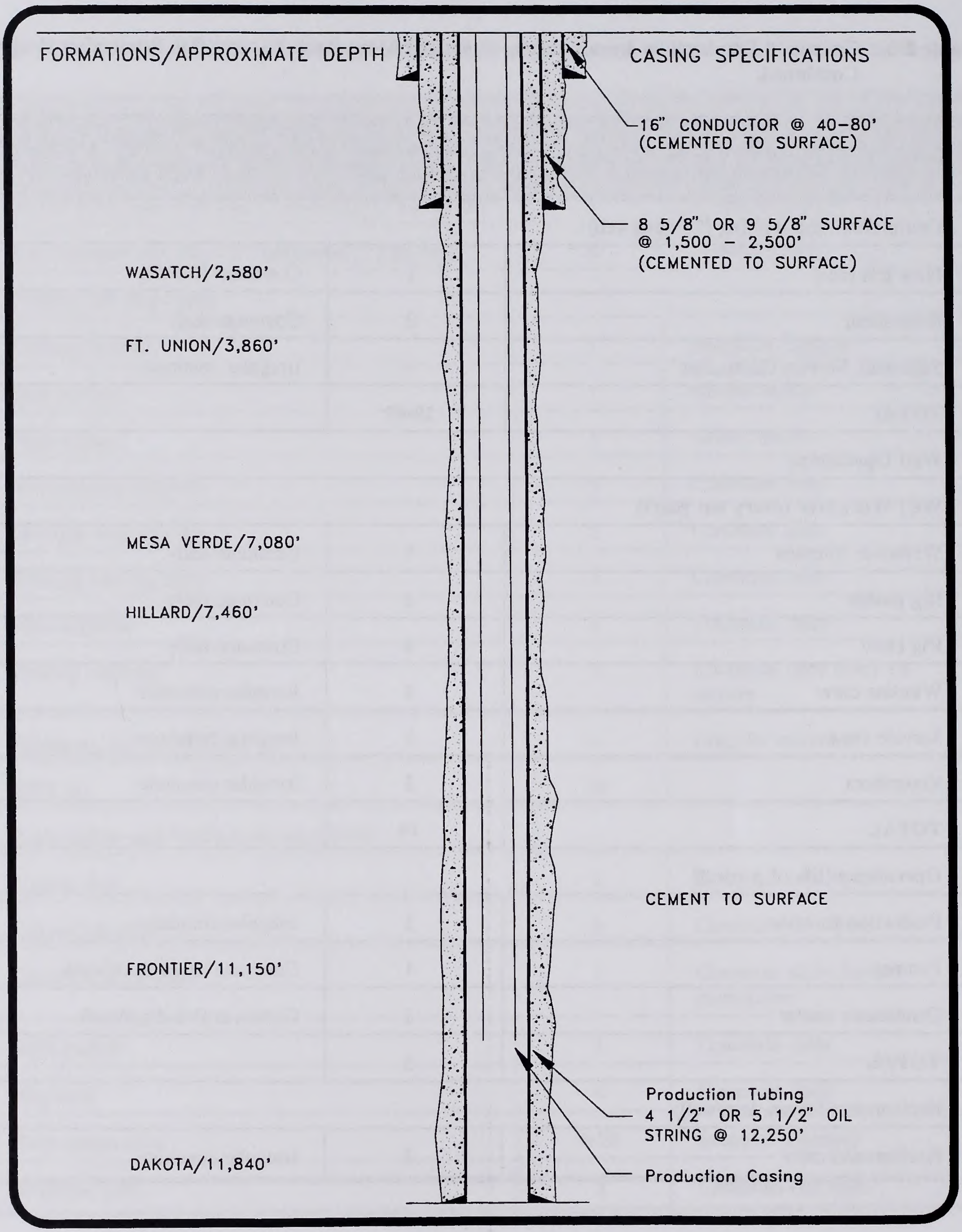


Exhibit 2-11. Typical Completed Wellbore Diagram for a Vertical Well.

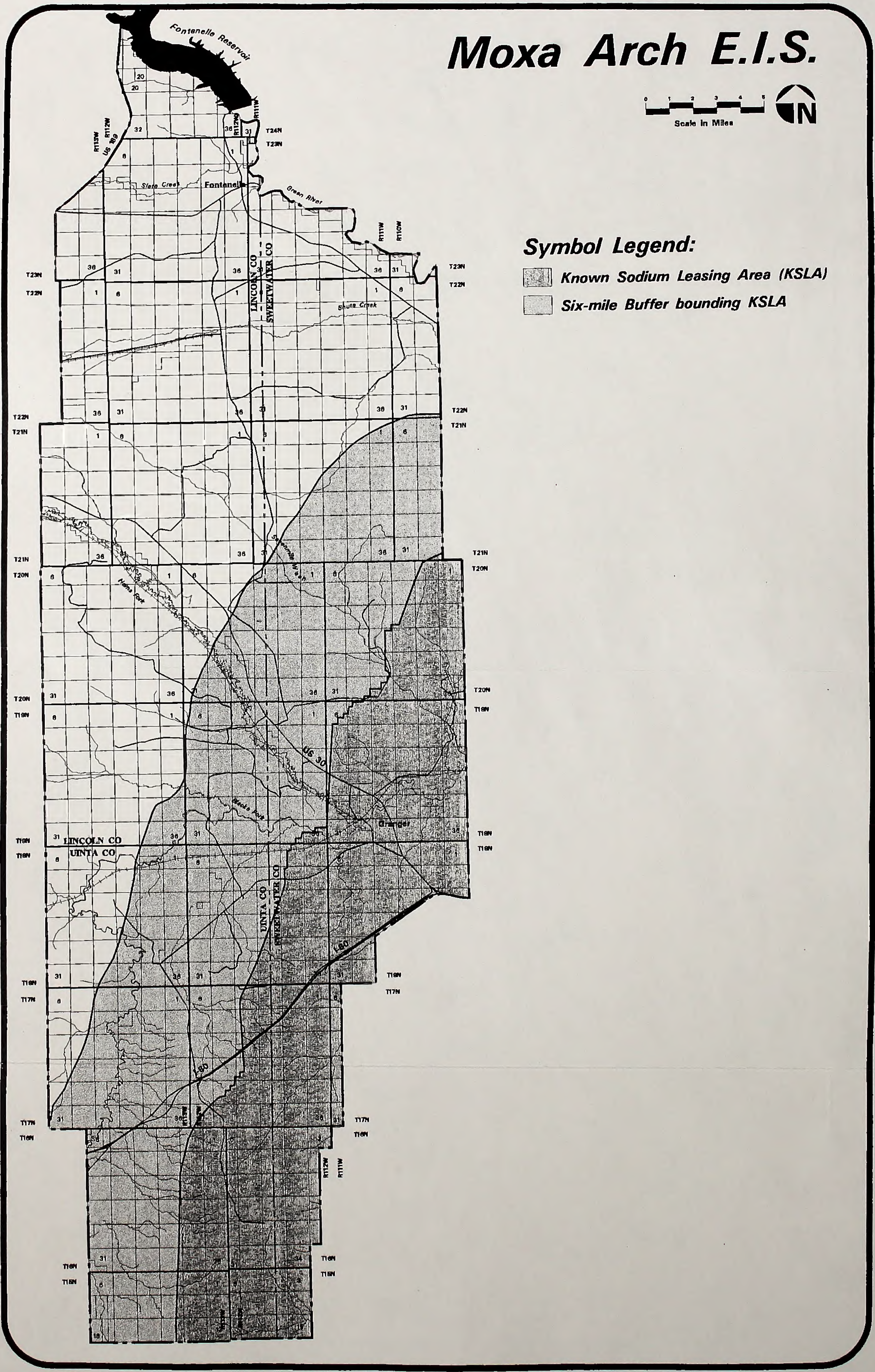


Exhibit 2-12. Six-Mile Buffer Boundary around the Known Sodium Leasing Area, Green River Basin, Wyoming.

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Most completions in the Moxa analysis area use a string of tubing that is inserted in the casing to the top of the perforated productive zone to allow gas, condensate, and water to flow to the surface where it is collected, measured, and contained. The gas from the Frontier and/or Dakota formations would be estimated and flared through testing procedures.

Depending on the rates of these flow tests, the formations would be further evaluated for stimulation. Most wells in the Moxa analysis area routinely need to be hydraulically fractured to increase flow rates. Fracturing (fracing) increases the formation's capability to produce and stimulates gas flow. Water-based fluids and proppant (i.e. granular substance such as sand grains or similar material carried in suspension by fracturing fluid that serves to keep the cracks open when the fracturing fluid is withdrawn after a fracture treatment) are pumped under pressure down the well bore and into the producing perforations. Carbon dioxide (CO_2) is added on some well fracing jobs.

Approximately 3,000-4,000 barrels of water can be used when water-based fluids are used in the fracing process. The pressurized fluids are returned to the surface where they are contained in a completion pit or tanks on location. For the next 15 days, the well is evaluated and tested for performance. Gas and condensate produced during testing are flared into the flare pit on location. Water produced with gas is generally considered to be condensed water vapor of low total dissolved solids (TDS) content. Estimated volumes based on Petroleum Institute (PI) reported production data within the Moxa analysis area average 5 bbls of produced water per 1,000 MCF of gas produced. Current production per well averages 700 MCF, so produced water averages 3.5 barrels of water per day (BWPD). Water disposal would be by means of a lined evaporation pit or disposal well.

Flaring of gas during completion operations would occur: 1) after the initial perforation of the Frontier and/or Dakota formations, if productive, and 2) during flowback operations following hydraulic fracture stimulation. Burnable products associated with flaring would be hydrocarbon gases and minor amounts of condensate. Incomplete combustion products (minor amounts of CO, NO_x) are possible.

Anticipated duration of flaring is expected to be 5 to 10 days. The purpose of flaring is to determine the magnitude of flow and presence of combustible hydrocarbons. In the event the well proves unproductive and the decision is made to abandon the well, the well would be plugged prior to abandonment (Exhibit 2-13). State and federal regulations dictate plugging details. Abandonment plugging consists of setting cement plugs in the well bore at specified intervals. The cement plugs would be pressure tested as they are installed (Exhibit 2-13). These cement plugs would seal off fluids in the formations penetrated by the well so that fluid from one formation would not escape into another formation or to the ground surface. The cementing process closes the well bore in such a way as to prevent the migration of oil, gas, or salt water.

2.2.3.2 Production Estimates

The following are expected natural gas production performances for the infill wells located within the Moxa analysis area.

Initial production rate -
1.5 million cubic feet per day (MMCFD)
+
12 barrels of condensate per day (BCPD)

Expected Reserves -
1.5 - 2.0 billion cubic feet (BCF)

Table 2-4 shows the content of typical produced gas within the Moxa analysis area.

2.2.3.3 Production Operations

Production operations within the Moxa analysis area would occur on a year-long basis, occasionally limited by ground and site conditions. Production operations would require use and maintenance of access roads within the Moxa analysis area on a year-round basis. Typical gravel road maintenance operations would occur during the summer and early fall months. Winter maintenance would include blading and blowing snow from the access road as necessary.

Each individual natural gas production site would be approximately 2.1 acres (300 feet by 300 feet). Central production facilities may be established for some areas

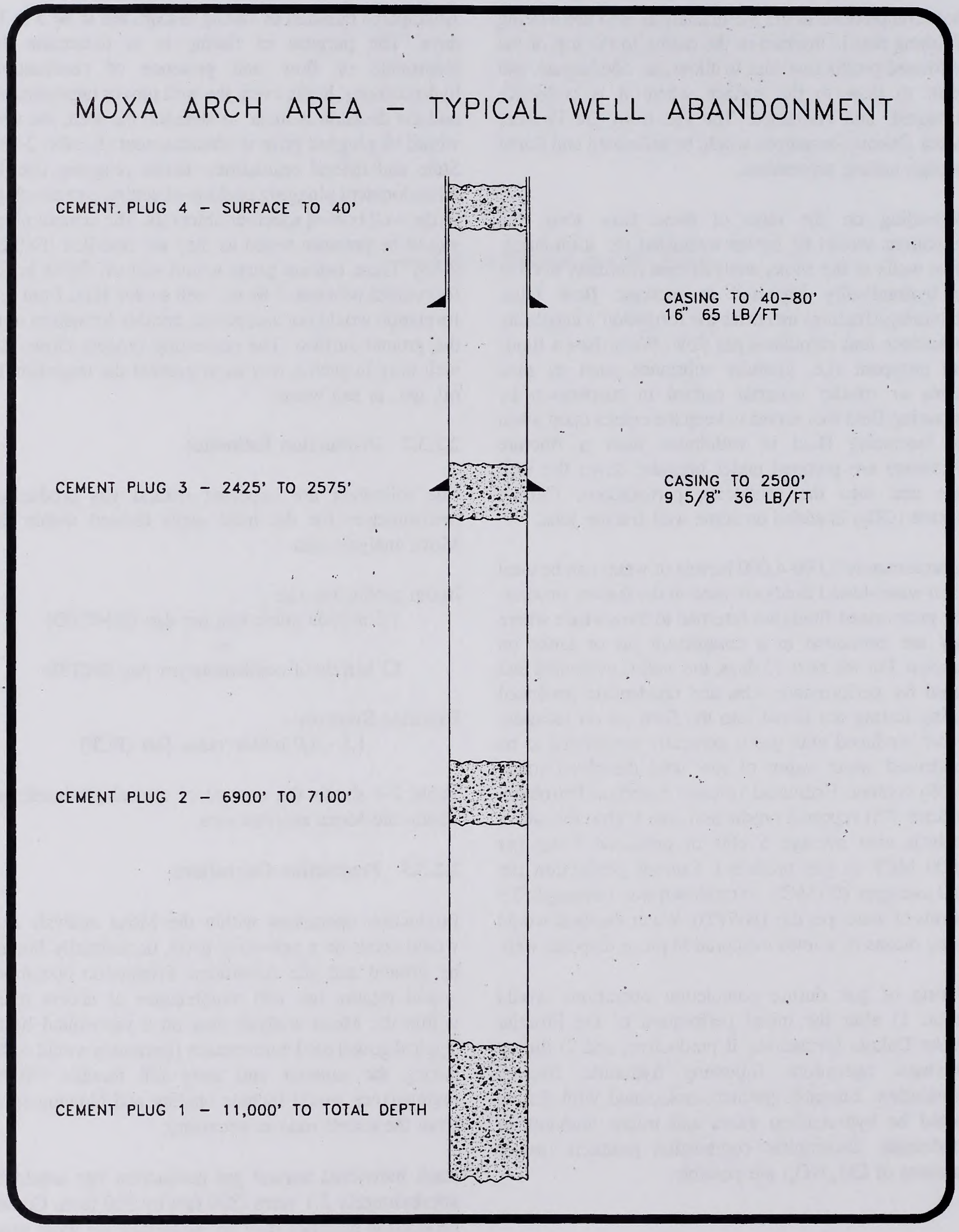
MOXA ARCH AREA – TYPICAL WELL ABANDONMENT
CEMENT PLUG 4 – SURFACE TO 40'
CASING TO 40–80'
16" 65 LB/FT
CEMENT PLUG 3 – 2425' TO 2575'
CASING TO 2500'
9 5/8" 36 LB/FT
CEMENT PLUG 2 – 6900' TO 7100'
CEMENT PLUG 1 – 11,000' TO TOTAL DEPTH

Exhibit 2-13. Typical Abandoned Wellbore Diagram.

Table 2-4. Typical Produced Gas in the Expanded Moxa Arch Area.[1]

Number	Component	Mole Fraction
1	Nitrogen - N_2	0.00930
2	Methane - C_1	0.81130
3	Carbon dioxide - CO_2	0.00400
4	Ethane - C_2	0.11370
6	Propane - C_3	0.0[illegible]70
[illegible]	Iso-butane - I-C_4	0.00590
8	Normal butane - N-C_4	0.00780
9	Iso pentane - I-C_5	0.00240
10	Normal pentane - N-C_5	0.00170
11	Normal hexane N-C_6	0.00510
	TOTAL	1.00000

[1] Gas Gravity = 0.6944.

serving two to four wells per facility. Alternatively, each producing well would be serviced by its own production facility.

Powerlines would not be required to operate the well or facilities. The production equipment would be powered by a series of solar cells and batteries. Some Operators have automated their wells. Other wells within the Moxa analysis area may eventually be automated, (i.e., measurements of gas and condensate would be obtained through an electronic gas measurement system).

2.2.3.4 Ancillary Facilities

The Proposed Action would utilize the existing ancillary facility infrastructure within the Moxa analysis area where possible, including gas compression facilities, power lines, water disposal and treatment facilities, and gas gathering pipelines.

Increased gas supply resulting from expansion of production operations would require additional gas compressor/treatment facilities. At present, one additional compressor station is planned for construction and operation in the Moxa analysis area. This facility would be located on private land in Section 29, Township 21 North, Range 112 West and would occupy an area of approximately seven acres.

2.2.3.5 Geophysical Operations

Additional geophysical operations are planned in the Moxa analysis area by the Moxa Operators. Within the near-term (one to three years), the majority of seismic data acquisition within the Moxa analysis area would likely be large scale three-dimensional surveys. The Moxa Operators intend to acquire three-dimensional seismic data along the west flank of the Moxa analysis area first, resulting in approximately 250 square miles of coverage within Townships 17-22 North and Ranges 113-114 West. Most data acquisition would be gathered using vibrators, primarily for economic and environmental reasons. Shot-hole dynamite may be used if field conditions, other limitations, or new acquisition criteria require such an operation.

The potential exists for continued 3-D seismic data acquisition in the long term (four to ten years) on the east flank of the Moxa analysis area as well. Approximately 250 square miles of additional coverage could occur within T17-22N and R110-111W, with most seismic activity occurring near current production.

2.2.3.6 Site Restoration and Abandonment

The Moxa Operators propose to completely reclaim all disturbed areas not needed for production activities including 1) pipeline ROW, 2) portion of road ROW not needed in the function of the road, and 3) the portion of the drill pad not needed during production. Reclamation would generally include 1) complete cleanup of the disturbed areas (drill sites, access roads, etc.); 2) restoration of the disturbed areas to the ground contour that existed prior to construction; 3) ripping of disturbed areas to a depth of 12 to 18 inches; 4) replacement of topsoil over all disturbed areas; and 5) seeding of reclaimed areas with the seed mixture prescribed in the Surface Use Plan or Plan of Development for the Proposed Action. Specific reclamation recommendations for use with the natural gas drilling and production operations within the Moxa are described in Appendix B. The final set of reclamation measures to be applied would be developed in the APD or ROW grant by each operator in consultation with the BLM and would be specific to each site and the conditions at that site.

As indicated previously, many disturbances would be reclaimed. Disturbances associated with drill sites would thereby be reduced by approximately 2.9 acres, leaving a 2.1-acre production pad in place. This would represent an approximate reduction of 3,843 acres for all 1,325 well sites. All pipeline ROWs would be reclaimed representing an approximate reduction of 8,838 acres. A portion of the disturbed road ROW would also be reclaimed. Only the road surface and drainage ditches would not be reclaimed, or approximately 30 feet (20-foot running surface and two five-foot drainage ditches). Therefore, approximately 1.45 acres would be reclaimed for each well for a total of 1,921 acres. Thus, during the production phase, the total construction disturbance of 20,293 acres (drill sites--6,625 acres; road--4,823 acres; pipelines--8,838 acres; and compressor station--seven acres) would be reduced by 14,602 acres to an unreclaimed total of 5,691 acres.

2.2.4 Project-Wide Mitigation Measures

The Moxa Operators propose to implement the following mitigation measures and procedures on *public lands* in order to avoid or mitigate resource or other land use impacts. These mitigation measures *may* be applied on privately owned surface and State of Wyoming lands *if* specified by the involved private and/or State surface owners. An exception to a mitigation measure and/or design feature may be approved on public land on a case-by-case basis when deemed appropriate by the BLM. An exception would be approved only after a thorough, site-specific analysis determined that the resource or land use for which the measure was put in place is not present or would not be significantly impacted.

The mitigation measures contained in the Amoco Production Company Moxa Arch Natural Gas Production Project Environmental Assessment and Decision Record (MAEA/DR, USDI-BLM 1991) and in the Supplemental Environmental Assessment to Amoco Production Company Moxa Arch Natural Gas Production Project Environmental Assessment and Decision Record (July 1992) will also be applicable to the Proposed Action and alternatives.

2.2.4.1 Preconstruction Planning and Design Measures

1) The Moxa Operators and the BLM will make on-site interdisciplinary team (IDT) inspections of each proposed and staked facility site (e.g., well sites, central facility site), new access road, access road reconstruction, and pipeline alignment projects so that site-specific recommendations and mitigation measures can be developed.

2) New road construction and maintenance of existing roads in the Moxa analysis area will be accomplished in accordance with BLM Manual 9113 standards unless private landowners or the State of Wyoming specify otherwise. While all parties operating in a given area are responsible for road maintenance, the lead operator (the operator with the greater number of wells) in an area will be responsible for administration of the formal or verbal road maintenance agreements. The road maintenance agreements will specify road work needed to accommodate field development activities.

3) Moxa Operators will prepare and submit an APD for each drill site on federal leases to the BLM for approval prior to initiation of construction. Also prior to construction, the Operators will submit a Sundry Notice and/or ROW application for each pipeline and access road segment on federal leases. The APD will include a Surface Use Plan that will show the layout of the drill pad over the existing topography, dimensions of the pad, volumes and cross-sections of cut-and-fill (when required), location and dimensions of reserve pit, and access road egress and ingress. The APD, Sundry Notice, and/or ROW application plan will also itemize project administration, time frame, responsible parties. In addition, a reclamation plan would be developed by each operator for each facility in consultation with the BLM following the guidelines presented in Appendix B, as needed. These guidelines include objectives of reclamation, characteristics of the predisturbance site conditions, topsoil removal, storage and handling, runoff and erosion control, seedbed preparation, seed mixes useful for livestock and wildlife, seed application, fertilization, mulching, site protection weed and livestock control, and monitoring and maintenance.

4) The operator will slope-stake construction activities when required by the BLM (e.g., steep and/or unstable slopes) and receive approval from the BLM prior to start of construction.

5) The operator will locate aggregate sources for any new construction material for use in drill site and access road construction and reconstruction on BLM or State surface. The appropriate surface management agency (BLM or State) must approve these sources, including timing for extraction, prior to use.

6) Generally, BLM would require consideration of using an existing well pad to directionally drill additional wells in sections where site occupancy limitations exist.

2.2.4.2 Resource-Specific Requirements

2.2.4.2.1 Range Resources and Other Land Uses

As listed under Soils, Vegetation and Wetlands, and Wildlife also apply to Range Resources and Other Land Uses.

1) The operator will coordinate with the affected livestock operators to ensure that livestock control structures remain functional during drilling and production operations.

2.2.4.2.2 Air Quality

1) Moxa Operators will not open burn garbage or refuse at the drill sites or other facilities.

2) When an air quality, soils loss, or safety problem is identified as a result of fugitive dust, immediate abatement would be initiated. The BLM will approve the procedure (e.g., application of water and magnesium chloride) for dust abatement at facility construction sites as well as locations for use and application rates. Water, if approved for this purpose, must be obtained by the operator from State-approved source(s).

2.2.4.2.3 Transportation

1) The Operators would jointly develop an area-wide transportation plan for road development and maintenance within the analysis area, identifying the minimum road network required to support operator drilling plans. This plan would utilize existing collector and local roads whenever possible.

2.2.4.2.4 Minerals/Paleontology

Mitigation measures presented in the Soils and Water Resources sections would avoid or minimize many of the potential impacts to the surface mineral resource. Protection of subsurface mineral resources from adverse impacts would be provided by the BLM casing and cementing policy described under Section 2.2.3.1.

Paleontological resource values would be protected through the following mitigation measures:

1) Areas of high paleontological potential will be surveyed by a qualified paleontologist on a project-by-project basis to identify and quantify the presence or potential presence of significant paleontological resources. If significant fossils are discovered in areas that are not monitored during construction, construction activities that could adversely affect the fossils would be redirected until a qualified paleontologist has determined the importance of the uncovered fossils, the extent of fossiliferous deposits, and made and implemented recommendations regarding further mitigation, if any are warranted.

2.2.4.2.5 Soils

1) Reduce the area of disturbance to the absolute minimum necessary for construction and production operations while providing for the safety of the operation. Restrict off-road vehicle activity.

2) Where feasible, locate pipelines immediately adjacent to roads to avoid creating separate areas of disturbance and in order reduce the total area of disturbance.

3) Implement measures identified in the reclamation guidelines (Appendix B), if and where needed throughout construction and rehabilitation activities.

4) Construction with wet or frozen soils will be prohibited.

5) Minimize construction activities in areas of steep slopes, and apply special slope stabilizing structures if construction cannot be avoided in these areas.

6) Design cutslopes in a manner that will allow retention of topsoil, surface treatment such as mulch, and subsequent revegetation.

7) Selectively strip and salvage topsoil or the best suitable medium for plant growth from all disturbed areas to a depth of up to 12 inches on all well pads.

8) Where possible, minimize disturbance to vegetated cuts and fills on existing roads that are improved.

9) Install runoff and erosion control measures such as water bars, berms, and interceptor ditches if needed, as prescribed in Appendix B.

10) Install culverts for ephemeral and intermittent drainage crossings. Design all drainage crossing structures to carry the 25- to 50-year discharge event, or as otherwise directed by the BLM.

11) Implement minor routing variations during access road layout to avoid steep slopes adjacent to ephemeral or intermittent drainage channels. Maintain a 100-foot wide buffer strip of natural vegetation where possible (not including wetland vegetation) between all construction activities and ephemeral and intermittent drainage channels.

12) Include adequate drainage control devices and measures in the road design (e.g., road berms and drainage ditches, diversion ditches, cross drains, culverts, out-sloping, and energy dissipators) at sufficient intervals and intensities to adequately control and direct surface runoff above, below, and within the road environment to avoid erosive concentrated flows. In conjunction with surface runoff or drainage control measures, use erosion control devices and measures such as temporary barriers, ditch blocks, erosion stops, mattes, mulches, and vegetative covers. Implement a timely revegetation program as soon as possible to re-establish the soil protection afforded by a vegetal cover.

13) Upon completion of construction activities, restore topography to near pre-existing contours at the well sites, along access roads and pipelines, and other facilities sites; replace up to six inches of topsoil or suitable plant growth material over all disturbed surfaces; apply fertilizer as required; seed (specified in a reclamation plan); and mulch.

2.2.4.2.6 Water Resources

Other mitigation measures listed in the Soils and Vegetation sections will also apply to Water Resources.

1) Implement measures identified in Appendix B, Reclamation Recommendations, throughout construction and rehabilitation activities if needed.

2) Construction of drainage crossings would be limited to no-flow periods or low-flow periods.

3) Minimize the area of disturbance within perennial, ephemeral and intermittent drainage channel environments.

4) Well sites, access roads, and pipelines will not be constructed within 500 feet of surface water and/or riparian areas. Exceptions to this would be granted by the BLM based on an environmental analysis and site-specific mitigation plans.

5) Channel crossings would be designed to minimize changes in channel geometry and subsequent changes in flow hydraulics.

6) Maintain vegetation barriers occurring between construction activities and ephemeral and intermittent channels.

7) Design and construct interception ditches, sediment traps/silt fences, water bars, silt fences and revegetation and soil stabilization measures as identified in Appendix B if needed.

8) Channel crossings by pipelines would be constructed such that the pipe is buried a minimum of four feet below the channel bottom.

9) Disturbed channel beds would be regraded to the original geometric configuration and the same or very similar bed material replaced.

10) Case wells during drilling, and case and cement all wells in accordance with Onshore Order No. 2 to protect accessible high quality water aquifers. High quality water aquifers are aquifers with known water quality of 10,000 TDS or less. Include well casing and welding of sufficient integrity to contain all fluids under high pressure during drilling and well completion. Further, wells will adhere to the Moxa Arch cementing policy described in Section 2.2.3.1.

11) Construct the reserve pit in cut rather than fill materials or compact and stabilize fill. Inspect the subsoil material of the pit to be constructed in order to assess soil stability and permeability and whether reinforcement and/or lining are required. If lining is required, line the reserve pit with a reinforced synthetic liner at least 12 mils in thickness and a bursting strength of 175 x 175 pounds per inch (ASTMD 75179). Consideration should be given to use of closed or semi-closed drilling systems in situations where a liner may be required.

12) Maintain two feet of freeboard on all reserve pits to ensure the reserve pits are not in danger of overflowing. Shut down drilling operations until the problem is corrected if leakage is found outside the pit.

13) Extract hydrostatic test water used in conjunction with pipeline testing and all water used during construction activities from sources with sufficient quantities and through appropriation permits approved by the State of Wyoming.

14) Discharge hydrostatic test water in a controlled manner onto an energy dissipator. The water is to be discharged onto undisturbed land that has vegetative cover, if possible, or into an established drainage channel. Prior to discharge, treat or filter the water to reduce pollutant levels or to settle out suspended particles if necessary. If discharged into an established drainage channel, the rate of discharge will not exceed the capacity of the channel to safely convey the increased flow. Coordinate all discharge of test water with the Wyoming SEO and the BLM.

15) All concentrated water flows within access road ROWs would be discharged onto or through an energy dissipator structure (e.g., riprapped aprons and discharge points) and discharged into undisturbed vegetation.

16) Develop and implement a pollution prevention plan (PPP) for storm water runoff at drill sites as required per Wyoming Department of Environmental Quality (WDEQ) storm water National Pollution Discharge Elimination System (NPDES) permit requirements. The WDEQ requires Operators to obtain a field permit for fields of 20 wells or more.

17) Exercise stringent precautions against pipeline breaks and other potential accidental discharges of toxic chemicals into adjacent streams. If liquid petroleum products are stored on-site in sufficient quantities (per criteria contained in 40 CFR Part 112), a Spill Prevention Control and Countermeasures (SPCC) plan

would be developed in accordance with 40 CFR Part 112, dated December 1973.

18) All crossings or encroachments of waters of the U.S. would be coordinated with the U.S. Army Corps of Engineers (COE).

2.2.4.2.7 Fisheries

1) No fisheries mitigation is needed beyond that indicated under Water Resources (2.2.4.2.6) and Special Status Species Fish (2.2.4.2.10). Under that category, the Windy Gap Decision (see Section 4.10.4 in Chapter 4 and the glossary) will be applied in the event of water depletion from Hams Fork, Blacks Fork, or the Green River.

2.2.4.2.8 Vegetation and Wetlands

Other mitigation measures under Soils and Water Resources will also apply to vegetation and wetlands.

1) Implement guidelines identified in Appendix B, if needed, throughout construction and rehabilitation activities.

2) Seed and stabilize disturbed areas with mixtures and treatment guidelines prescribed in Appendix B if needed.

3) File noxious weed monitoring forms with the BLM and implement, if necessary, a weed control and eradication program.

4) Evaluate all project facility sites for occurrence and distribution of waters of the U.S., special aquatic sites, and jurisdictional wetlands. All project facilities would be located out of these sensitive areas. If complete avoidance is not possible, minimize impacts through modification and minor relocations. Coordinate activities that involve dredge or fill into wetlands with the COE.

5) A site-specific survey for plant species of concern and their habitat would be completed for the Moxa analysis area prior to initiation of any ground-surface disturbance. If species of concern or their habitat are found, impacts would be minimized and monitored. Minor adjustments to the location of project facilities would be made to avoid plant species of concern and/or their habitat. Copies of these surveys would be provided to the District Botanist and the Resource Area Wildlife Biologist.

2.2.4.2.9 Wildlife

1) Require that regular drivers undergo training describing the types of wildlife in the area that are susceptible to vehicular collisions, the circumstances under which such collisions are likely to occur, and the measures that can be employed to minimize them.

2) During reclamation, establish a variety of forage species that are useful to resident herbivores based on the seed mixes presented in Appendix B or the BLM-approved seed mix.

3) Prohibit unnecessary off-site activities of operational personnel in the vicinity of the drill sites. Inform all project employees of applicable wildlife laws and penalties associated with unlawful take and harassment.

4) To facilitate big game movements and minimize the potential for injuries, do not fence access road ROWs.

5) Limit construction activities as per BLM authorizations within big game crucial winter range from November 15 to April 30.

6) Well sites within one mile of previously identified raptor nests should be surveyed and cleared prior to the commencement of drilling and construction during the raptor nesting period.

7) When an ‘active’ raptor nest is within 0.25 to one mile (depending on species and line of sight) of a proposed well site, restrict construction during the critical nesting season for that species.

8) Conduct aerial surveys in the analysis area prior to any construction to determine locations of sage grouse leks. Follow-up with ground surveys (March through mid-June) to determine exact lek locations. (Note: A survey for sage grouse leks has been completed for the analysis area as a part of the scope of analysis for the EIS).

9) Do not perform construction activities within 0.25 mile of existing sage grouse leks at any time except as

authorized in writing by exception, including documented supporting analysis, by the Authorizing Official.

10) Provide for sage grouse lek protection during the breeding, egg-laying and incubation period (normally March through mid-June) by restricting construction activities within a two-mile radius of active sage grouse leks. Exceptions may be granted if the activity will occur in unsuitable nesting habitat.

11) Map prairie dog colonies within the Moxa analysis area, and consult with the U.S. Fish and Wildlife Service (FWS) to determine if black-footed ferret searches are necessary. When ferret searches are required, they would be conducted no more than 12 months prior to construction. Note: Mapping of prairie dog colonies has been completed in the analysis area as a part of the scope of analysis for the EIS).

2.2.4.2.10 Special Status Species

Special Status Plants

1) Employ site-specific recommendations developed by an IDT for staked facilities.

2) Minimize impacts due to clearing and soil handling.

3) Monitor and control noxious weeds.

4) Comply with Section 404(b)(1) guidelines of the federal Clean Water Act (CWA).

5) Perform clearance surveys for plant species of concern.

Special Status Animals

1) In compliance with the Endangered Species Act (ESA), implement measures discussed in Chapter 4, Section 4.9.6 under Wildlife.

Special Status Fish

1) Apply the FWS Windy Gap Decision (see Chapter 4, Section 4.10.4 under special status fish and the glossary) in the event of water depletion from Hams Fork, Blacks Fork, or the Green River to offset possible impacts and avoid jeopardy to the endangered and candidate fish species of the mainstem Green River and upper Colorado River Basin.

2.2.4.2.11 Visual Resources

1) Utilize existing topography to screen roads, pipeline corridors, drill rigs, well heads, and production facilities from view.

2) Paint well and central facilities site structures with flat colors (e.g., Carlsbad Canyon or Desert Brown) that blend with the adjacent surrounding undisturbed terrain, except for structures that require safety coloration in accordance with Occupational Safety and Health Administration (OSHA) requirements.

2.2.4.2.12 Noise

1) Muffle and maintain all motorized equipment according to manufacturers' specifications.

2.2.4.2.13 Recreation

1) Minimize conflicts between project vehicles and equipment and recreation traffic by posting appropriate warning signs, implementing operator safety training, and requiring project vehicles to adhere to low speed limits.

2.2.4.2.14 Socioeconomics

1) Implement hiring policies that will encourage the use of local or regional workers who will not have to relocate to the area.

2) Coordinate project activities with ranching operations to minimize conflicts involving livestock movement or other ranch operations. This will include scheduling of project activities to minimize potential disturbance of large-scale livestock movements. Establish effective and frequent communication with affected ranchers to monitor and correct problems and coordinate scheduling.

2.2.4.2.15 Cultural Resources

1) If a site is considered eligible for, or is already on the National Register of Historic Places (NRHP),

avoidance is the preferred method for mitigating adverse effects to that property.

2) Mitigation of adverse effects to cultural/historical properties that cannot be avoided would be accomplished by the preparation of a cultural resources mitigation plan.

3) If cultural resources are discovered at any time during construction, all construction activities will halt and BLM personnel would be immediately notified. Work will not resume until a Notice to Proceed is issued by the BLM.

2.2.4.2.16 Health and Safety

Measures listed under Air Quality and Water Quality also apply to Health and Safety.

1) Sanitation facilities installed on the drill sites and any resident camp site locations would be approved by the WDEQ.

2) To minimize undue exposure to hazardous situations, require measures that would preclude the public from entering hazardous areas and place warning signs alerting the public of truck traffic.

3) Haul all garbage and rubbish from the drill site to a State-approved sanitary landfill for disposal. Collect and store any garbage or refuse materials on location prior to transport in containers approved by the BLM.

4) During construction and upon commencement of production operations, Moxa Operators will have a chemical or hazardous substance inventory for all such items that may be at the site. Moxa Operators will institute a Hazard Communication Program for its employees and will require subcontractor programs in accordance with OSHA 29 CFR 1910.1200. These programs are designed to educate and protect the employees and subcontractors with respect to any chemicals or hazardous substances that may be present in the work place. It will be required that as every chemical or hazardous material is brought on location, a Material Safety Data Sheet (MSDS) will accompany that material and will become part of the file kept at the field office as required by 29 CFR 1910.1200. All employees will receive the proper training in storage, handling, and disposal of hazardous substances.

5) SPCC plans will be written and implemented as necessary in accordance with 40 CFR Part 112 to prevent discharge into navigable waters of the United States.

6) Chemical and hazardous materials will be inventoried and reported in accordance with the Superfund Amendments and Reauthorization Act (SARA) Title III. 40 CFR Part 335, if quantities exceeding 10,000 pounds or the threshold planning quantity (TPQ) are to be produced or stored in association with the Proposed Action. The appropriate Section 311 and 312 forms will be submitted at the required times to the State and County Emergency Management Coordinators and the local fire departments.

7) Any hazardous wastes, as defined by the Resource Conservation and Recovery Act (RCRA), will be transported and/or disposed of in accordance with all applicable federal, state, and local regulations.

8) Moxa Operators plan to design operations to severely limit or eliminate the need for Extremely Hazardous substances. Moxa Operators also plan to avoid the creation of hazardous wastes as defined by RCRA wherever possible.

Appendix D (Hazardous Substance Management Plan) provides a summary of the hazardous chemicals that may be on a drilling or production site with examples of representative chemicals and associated physical and health hazards. At this time it is impossible to determine if these items will be stored in sufficient quantities to require reporting under SARA Title II, and in some cases, the items may not be on site at all. However, all items will become part of the Hazard Communications Plan where required, and employee training will be completed as required.

2.3 ALTERNATIVE A - DEVELOP AN ADDITIONAL 795 WELLS WITHIN THE EXPANDED MOXA ARCH NATURAL GAS PRODUCTION AREA IN ADDITION TO EXISTING OPERATIONS (MINIMUM DEVELOPMENT SCENARIO).

Alternative A provides a minimum development scenario of 795 production well sites (610 wells within the proven productive area and 185 wells within the flank area), with related roads, pipelines, and production facilities. As previously mentioned, the precise number of wells, locations of the wells, and timing of drilling would be directed by the success of development drilling and production technology, and economic considerations such as cost of development of leases having marginal profitability.

The technical requirements for Alternative A, including the project-wide mitigation measures, are the same as described for the Proposed Action; however, less overall site disturbance is necessary for the well sites, access roads, pipelines, and other ancillary facilities. The construction of this alternative would involve 3,975 acres of drill site disturbance, 2,894 acres (477 miles of new road with a 50-foot construction ROW) of road disturbance, 5,303 acres (875 miles within a 50-foot ROW) of pipeline disturbance, and seven acres of compressor station disturbance, for a total of approximately 12,179 acres. A large portion of this area would be reclaimed as described under the Proposed Action, thus reducing the total disturbance by 8,762 acres to 3,417 acres.

2.4 ALTERNATIVE B - NO ACTION

Section 1502.14(d) of the National Environmental Policy Act (NEPA) requires that the alternatives analysis in the EIS "include the alternative of no action." "No Action" implies that on-going natural gas production activities would be allowed to continue by the BLM in the Expanded Moxa Arch Natural Gas Development Area, but the proposed field development program (Proposed Action) would be disallowed. Additional APDs and ROW actions would be granted by the BLM for federal land on a case-by-case basis consistent with the scope of existing environmental analysis. Transport of natural gas products would be allowed from those wells within the Moxa analysis area that are currently productive. Additional oil/gas development could occur on State and private lands within the analysis area under APDs approved by the WOGCC.

The U.S. Department of the Interior's (USDI) authority to implement a "No Action" alternative is limited because the public lands have already been leased. An explanation of this limitation and the discretion the USDI has in this regard follows.

- An oil and gas lease grants the lessee the "right and privilege to drill for, mine, extract, remove and dispose of all oil and gas deposits" in the leased lands, subject to the terms and conditions incorporated in the lease (Form 3110-2). Because the Secretary of the Interior has the authority and responsibility to protect the environment within federal oil and gas leases, restrictions are imposed on the lease terms.

- Leases within the Moxa analysis area contain various stipulations concerning surface disturbance, surface occupancy and limited surface use. In addition, the lease stipulations provide that the USDI may impose "such reasonable conditions, not inconsistent with the purposes for which [the] lease is issued, as the [BLM] may require to protect the surface of the leased lands and the environment." None of the stipulations, however, would empower the Secretary of the Interior to deny all drilling activity because of environmental concerns.

- Provisions in leases that expressly provide Secretarial authority to deny or restrict APD development in whole or in part would depend on an opinion provided by the FWS regarding impacts to endangered or threatened species or habitats of plants or animals that are listed or proposed for listing (e.g., bald eagle). If the FWS concludes that the Proposed Action and alternatives would likely jeopardize the continued existence of any endangered or threatened plant or animal species, then the APD(s) and Moxa development may be denied in whole or in part.

2.5 ALTERNATIVES CONSIDERED BUT NOT ANALYZED IN DETAIL

Alternatives considered but not further evaluated included possible variations in well spacing. As noted in Chapter 1 (Exhibit 1-4) and as provided in approved Unit Agreements and Spacing Orders within Moxa, spacing limitations are imposed within much of the Moxa analysis area. The fields are predominantly spaced for two wells and four wells per section, with WOGCC Rule 302 allowing Moxa Operators to drill four wells per section in unspaced areas.

As previously discussed in this Chapter (Section 2.1), the Proposed Action of developing 1,325 well locations in addition to existing drilling and production operations, and Alternative A, the minimum development level of 795 additional well sites, were determined by summarizing drilling plans projected by the Moxa Operators over the next ten-year planning period. Drilling estimations were based on present WOGCC-approved spacing within the individual fields, and reasonably foreseeable spacing and drilling projections into areas within the Moxa analysis area where the majority of planned activity would occur. Estimations also took into account reservoir characteristics and geology, flow potential from existing producers, expected recovery factors, and economics of drilling and production operations. These estimations concluded that a maximum development level of four wells per section is deemed appropriate for most of Moxa. Some presently undefined areas of below average recovery of gas reserves may justify well densities of five to eight wells per section. As stated in Section 2.1, increasing density beyond four wells per section would depend not only on reservoir and recovery considerations, but also on gas prices, well, costs, and economics.

Because the rationale provided by Moxa Operators as discussed in Section 2.1, no additional alternatives involving variations in well spacing were considered and analyzed in detail. No other alternatives other than variations in well spacing were considered or evaluated.

2.6 COMPARISON OF ENVIRONMENTAL IMPACTS OF FIELD DEVELOPMENT ALTERNATIVES AND CUMULATIVE EFFECTS

2.6.1 Comparison of Field Development Alternatives

The cumulative effects of the two field development alternatives analyzed in this EIS are compared in the following text. The Proposed Action is the projected additional disturbance caused by the implementation of the maximum development program of 1,325 well locations. Alternative A represents a minimum level of additional site disturbance associated with the development of 795 wells.

Each development alternative would involve clearing land and constructing well sites, access roads, pipelines, and associated facilities. Where practical, pipelines would be routed along existing and/or new roadways, with an estimated disturbance width of 50 feet and an estimated average length of 1.1 miles. As such, new pipeline construction to each well site is estimated to impact 6.67 acres. New road construction necessary to access each new well site is estimated at 0.6 mile per well site or approximately 3.64 acres. The average well site disturbance is estimated to be 5.0 acres to construct a drill pad ranging in size from 3.4 acres to 3.67 acres (approximately 400 feet by 400 feet) depending on site conditions.

Given these estimated impact values, the Proposed Action would cause a short-term effect of approximately 8,838 acres resulting from pipeline construction (1,458 miles with a 50-foot ROW), 4,823 acres from access road construction (795 miles with a 50-foot ROW), and 6,625 acres from well sites (1,325 well sites with 5.0 acres of disturbance per site). Alternative A (minimum development) would cause a short-term effect of approximately 5,303 acres resulting from pipeline construction (875 miles with a 50-foot ROW), 2,894 acres from access road construction (477 miles with a 50-foot ROW), and 3,975 acres from well sites (795 well sites with five acres of disturbance per site). A seven-acre compressor station would be constructed under both alternatives. Thus, under the Proposed Action, total disturbance would be approximately 20,293 acres in contrast with Alternative A, 12,179 acres. In the long term, the total area of disturbance would be reduced during the production phase through reclamation of disturbances associated with the unused portion of road ROW, pipeline ROW, and drill sites. As such, under the Proposed Action, total disturbance would be reduced from 20,293 acres to 5,691 acres. Similarly, under Alternative A, total disturbance would be reduced from 12,179 acres to 3,417 acres. The residual unreclaimed disturbances would be occupied by facility footprints that are actively used during the production phase.

Table 2-5 presents a qualitative/quantitative comparison of impacts between the Proposed Action and Alternatives A and B for each resource element. Further details on the type and extent of impacts to each resource are presented in Chapter 4, Environmental Consequences. Additionally, Table 2-5 identifies compliance with applicable guidelines and indicates if impacts would be significant and unmitigable, significant but mitigable, or non-significant. Only Visual Resources has the potential for significant impacts, even with the mitigation measures presented in this chapter and with measures presented in Section 4.11.7. All other resources would experience either non-significant impacts or impacts that should be mitigated to non-significant levels.

2.6.2 Summary of Cumulative Effects

Cumulative effects are impacts likely to occur due to the proposed project in combination with other on-going activities, recently constructed projects, and projects likely to be implemented in the near future. Cumulative effects are both additive and interactive. Chapter 4 discusses these effects under each resource discipline section. This section identifies the basic existing cumulative disturbance within the Moxa analysis area as a baseline for the analysis presented in Chapter 4 of each resource discipline section.

Since the cumulative impacts assessment involves the degree of existing disturbance, detailed photo interpretation was completed for the Moxa analysis area (aerial photography taken May 1994). Six categories of disturbance were identified (Table 2-6) and the area of impact determined for the total Moxa area.

Based on the aerial photography taken in May 1994, approximately 977 single well/drill sites were identified and delineated. This count differs from the 1,119 wells identified previously due to 1) not all wells were identified on the aerial photos because of the small scale and 2) some of the 1,119 wells were initiated after June 1994. Using an average disturbance of five acres per site, the total disturbance associated with the identified 977 drill/well sites is approximately 4,885 acres. This represents 19 percent of the existing disturbance. Existing roads, pipelines, and facilities represent 44.0 percent, 25.0 percent, and six percent of the Moxa analysis area, respectively. Urban and railroad categories comprise less than one percent and six percent, respectively, of the existing Moxa disturbance. Thus, the total unreclaimed disturbance was approximately 25,999 acres, or around 5.5 percent of the 476,261-acre analysis area. This total represents all disturbance without taking reclamation into consideration. Preliminary aerial photo interpretation indicated that reclaimed areas could not be feasibly distinguished from unreclaimed areas due to the relatively small scale of the aerial photos (nominal scale of 1:24,000). However, a correction can be made to estimate the current area (as of May 1994) that has been or is in the process of being reclaimed. Approximately 40.0 percent of the road disturbance has been reclaimed per BLM standards resulting in a reduction of 4,612 acres to 6,918 acres. Similarly, all pipelines have been or are in the process of being reclaimed, thus representing a reduction of 6,520 acres. In general, drill sites have been reclaimed to approximately a 2.1-acre well pad size, thereby reducing such disturbances to 2,052 acres. Well abandonment is expected to be 2 to 4 wells per year over the ten-year production period. Facilities site disturbance cannot be significantly reduced. Therefore, taking past, current, and future reclamation into account, the total existing unreclaimed disturbance is approximately 12,034 acres or 2.5 percent of the 476,261-acre analysis area.

Site disturbance resulting from implementation of the Proposed Action and Alternative A would add cumulatively to the degree of disturbance within the Moxa analysis area. The 20,293 acres of short-term impact for the Proposed Action would increase the area of total disturbance within the Moxa analysis area to 46,292 acres, or 9.7 percent of the analysis area. Alternative A would bring the total disturbance to 38,178 acres (8.0 percent).

Table 2-5. Comparative Impact Summary.

RESOURCE ELEMENT	PROPOSED ACTION	ALTERNATIVE	
		A	B-No Action
General			
Number of Wells	1,325	795	UAD
Pipeline (miles)	1,458	875	UAD
New Road (miles)	795	477	UAD
Disturbance (acres) before reclamation after reclamation	 20,293 5,691	 12,179 3,417	 UAD UAD
Cumulative Disturbance in Moxa (acres) before reclamation after reclamation	 46,292 17,725	 38,178 15,451	 25,999 + UAD 14,828 + UAD
Range Resources	**NSI w/ mitigation**	**NSI w/ mitigation**	**NSI w/ mitigation**
Compliance with RMP	YES	YES	YES
AUMs Lost Per Year for 10 Years	26.5	15.8	UAD
Air Quality	NSI	NSI	NSI
Compliance with RMP	YES	YES	YES
Compliance with WAAQS and NAAQS	YES	YES	YES
Emissions Rates per Well (µg/m^3) Annual PM$_{10}$ Annual NO$_x$ CO (1 hr, 8 hr) SO$_2$ (3 hr, 24 hr, Annual)	(in addition to background) + 4.94 + 8.41 +137.12, +57.78 +70.5, +34.09, +0.51	Lower than Proposed Action	background 12 (+ UAD) 3 (+ UAD) 3500, 1500 (+ UAD) 63, 32, 2 (+ UAD)
Visibility Reduction	<0.005 percent	Lower than Proposed Action	Lower than Proposed Action
Transportation	NSI	NSI	NSI
Compliance with RMP	YES	YES	YES
Traffic Volume (ADT relative to 1993 data) I-80 U.S. 30 U.S. 189 WY 372 WY 240	 10,470 2,200 1,035 968 320	Lower than Proposed Action	 10,042 + UAD 1,852 + UAD 998 + UAD 914 + UAD 304 + UAD
Minerals/Paleontology	**NSI w/ mitigation**	**NSI w/ mitigation**	**Potential SI**
Compliance with RMP	YES	YES	YES
Disturbance to Fossil Resources	UNKI	UNKI	UNKI
Soils	**NSI w/ mitigation**	**NSI w/ mitigation**	**NSI w/ mitigation**
Compliance with RMP	YES	YES	YES

Table 2-5. Comparative Impact Summary, Continued.

RESOURCE ELEMENT	PROPOSED ACTION	ALTERNATIVE	
		A	B-No Action
Soils, Continued			
Acres developable with NSI (with mitigation)	390,500	Same as Proposed Action	Same as Proposed Action
Cumulative Disturbance (w/ Reclamation) w/i the Analysis Area (476,261 ac) w/i the CIA Area (2,021,167 ac)	 3.7 percent 1.4 percent	 3.2 percent 1.3 percent	 2.5 percent + UAD 1.1 percent + UAD
Erosion: Year 1 (tons/year) w/o BMPs w/ BMPs	 227,210 + baseline 71,923 + baseline	 136,340 + baseline 43,161 + baseline	 baseline (+ UAD) baseline (+ UAD)
Additional Erosion: Year 5 (tons/year) w/o BMPs w/ BMPs	 + 87,200 + 33,954	 + 52,328 + 20,376	 + UAD + UAD
Compliance with EO 11987 (reclamation)	YES	YES	YES
Revegetation Potential Sensitive Soils - badlands, sand dunes, Sensitive Soils - steep slopes, wetlands, and floodplains Non-sensitive Soils and saline/sodic soils	 Very Poor to Poor Fair to Good Fair to Good	Same as Proposed Action	Same as Proposed Action
Water Resources	NSI w/ mitigation	NSI w/ mitigation	NSI w/ mitigation
Compliance with RMP	YES	YES	YES
Compliance with CWA and State Water Quality Standards	YES	YES	YES
Compliance with Colorado River Basin Salinity Control Act	YES	YES	YES
Water Use (acre-feet/year)	220	132	Current use + UAD
Sedimentation: Year 1 (tons/year) w/o erosion control w/ erosion control	 22,721 + baseline 7,192 + baseline	 13,634 + baseline 4,316 + baseline	 baseline (+ UAD) baseline (+ UAD)
Groundwater Quality Degradation Potential	Low	Lower than Proposed Action	Lower than Proposed Action
Fisheries	NSI w/ mitigation	NSI w/ mitigation	NSI w/ mitigation
Compliance with RMP	YES	YES	YES
Vegetation & Wetlands	NSI w/ mitigation	NSI w/ mitigation	NSI w/ mitigation
Compliance with RMP	YES	YES	YES
Compliance with Section 404 of the Clean Water Act and with EOs 11990 (wetlands) and 11988 (floodplains)	YES	YES	YES
Potential Impact to Plant Communities of Concern	Low	Lower than Proposed Action	Lower than Proposed Action

Table 2-5. Comparative Impact Summary, Continued.

RESOURCE ELEMENT	PROPOSED ACTION	ALTERNATIVE	
		A	B-No Action
Vegetation & Wetlands, Continued			
Cumulative Cover Type Impacts in the Analysis Area (with reclamation)			
Mixed Desert Shrub	7 percent	7 percent	6 percent + UAD
Vegetated Sand Dunes	7 percent	6 percent	5 percent + UAD
Alkali Scrub	9 percent	8 percent	7 percent + UAD
Barren Land	4 percent	3 percent	2 percent + UAD
Agricultural Lands	10 percent	10 percent	9 percent + UAD
Wetlands	4 percent	4 percent	3 percent + UAD
Wildlife	**NSI w/ mitigation**	**NSI w/ mitigation**	**NSI w/ mitigation**
Compliance with RMP, FWS, and WGFD objectives and stipulations	YES	YES	YES
Loss of Pronghorn Crucial Winter Range and Severe Winter Relief Range (acres)			
before reclamation	7,052 + baseline	3,863 + baseline	baseline + UAD
after reclamation	4,935 + baseline	2,703 + baseline	
Loss of Elk Severe Winter Relief Range (acres of impact before reclamation)	1,540 + baseline	981 + baseline	baseline + UAD
Loss of Potential Sage Grouse Yearlong Habitat (acres of impact before reclamation)	6,956 + baseline	3,867 + baseline	baseline + UAD
Special Status Species			
Compliance with RMP and/or WGFD: Plants, Animals, and Fish	YES	YES	YES
Potential Disturbance to Special Status Plants (acres)	UNKI (highest)	UNKI (intermediate)	UNKI (lowest)
Disturbance to Habitat for Special Status Animals over ten-year period (acres)	before reclamation	before reclamation	before reclamation
Black-Footed Ferret	1,949	1,353	UAD
Pygmy Rabbit	354	153	UAD
Ferruginous Hawk	126 to 503*	126 to 503*	UAD
Mountain Plover	153	92	UAD
Loggerhead Shrike	1,763	995	UAD
Burrowing Owl	1,949	1,363	UAD
Potential Disturbance to Special Status Fish	Minimal	Minimal	Minimal

Table 2-5. Comparative Impact Summary, Continued.

RESOURCE ELEMENT	PROPOSED ACTION	ALTERNATIVE	
		A	B-No Action
Wildlife, Continued			
ESA Conclusion			
Listed Plants	not likely to adversely affect	Same as Proposed Action	Same as Proposed Action
Candidate Plants	not likely contribute to the need to list		
Listed Wildlife	not likely to adversely affect		
Candidate Wildlife	not likely contribute to the need to list		
Listed Fish	not likely to adversely affect		
Candidate Fish	not likely contribute to the need to list		
Visual Resources	**Potential SI**	**Potential SI**	**Potential SI**
Compliance with RMP	Conditional	Conditional	Conditional
Compliance with BLM VRM Class	Conditional. NSI - Class IV; Potential long-term SI in Class II and III VRM areas	Conditional. NSI in Class IV; SI if new wells in Class II VRM Zones are not screened; SI if >2 wells/mi^2 in Class III Zones	May already exceed Class III along Hwy 30; NSI - Class IV; SI if >2 wells/mi^2 in Class III areas; SI if additional wells in Class II Zones not screened
Cumulative Visual Character[1]			
I-80	possible change to HD	possible change to HD	CN/HI, possible HD
U.S. 189	change to CN/HI	change to CN/HI	CN, possible CN/HI
U.S. 30	change to CN/HI, possible HD	change to CN/HI, possible HD	CN, possible CN/HI, possible HD
Noise	**NSI**	**NSI**	**NSI**
Compliance with RMP	No standards specified	No standards specified	No standards specified
Construction and Traffic Noise	Moderate	Lower than Proposed Action	Lower than Proposed Action
Recreation	**NSI w/ mitigation**	**NSI w/ mitigation**	**NSI w/ mitigation**
Compliance with RMP	YES	YES	YES
Quality of Recreation Experience	Lowest	Higher than Proposed Action	Higher than Proposed Action
Displacement of Recreation	Highest	Lower than Proposed Action	Lower than Proposed Action
Socioeconomics	**NSI, positive**	**NSI**	**NSI**
Compliance with RMP	No standards specified	No standards specified	No standards specified
Employment Rate	Continue	Lower than Proposed Action	Lower than Proposed Action
Economic Revenue (over 1993 revenues)			
1996 Ad Valorem:			
Lincoln County	+5.8 percent	-30 percent of PA	Lower than Proposed Action
Sweetwater County	+1.6 percent	-51 percent of PA	
Uinta County	+1.9 percent	-47 percent of PA	

Table 2-5. Comparative Impact Summary, Continued.

RESOURCE ELEMENT	PROPOSED ACTION	ALTERNATIVE	
		A	B-No Action
Socioeconomics, Continued			
Annual increase in sales and use tax revenues (over 1993 revenues) Lincoln County Sweetwater County Uinta County	 +11.7 percent +2.1 percent +3.8 percent	 -29 percent of PA -48 percent of PA -45 percent of PA	Lower than Proposed Action
Cultural Resources	**NSI w/ mitigation**	**NSI w/ mitigation**	**NSI w/ mitigation**
Compliance with RMP	YES	YES	YES
Compliance with the NRHP[2] guidelines	YES	YES	YES
Sites Eligible for the NRHP in the Moxa Analysis Area	678 Prehistoric 58 Historic	Same as Proposed Action	Same as Proposed Action
Impacts to Known or Anticipated Cultural Resources	Highest potential	Lower than Proposed Action	Lower than Proposed Action
Health & Safety	NSI	NSI	NSI
Compliance with RMP	YES	YES	YES
Risk to the Public	Highest potential	Lower than Proposed Action	Lower than Proposed Action

Abbreviations:

ADT - Average daily traffic
AUM - Animal Unit Month
CWA - Clean Water Act
EO - Executive Order
ESA - Endangered Species Act
FWS - Fish and Wildlife Service
NA - Not applicable
NSI - No significant impacts
RMP - Resource Management Plan
SI - Significant impacts
UAD - Unquantified additional development
UNKI - Unknown impact until site-specific location is proposed and surveys are completed
VRM - Visual Resource Management
WGFD - Wyoming Game and Fish Department
w/ - with
w/i - within
w/o - without
μg/m³ - micrograms per cubic meter
1 - HD = Human Dominated, CN = Common Natural, HI = Human Influenced
2 - National Register of Historic Places
***** per active nest site

Successful reclamation of well, road, and pipeline construction activity would reduce the area of long-term disturbance by the Proposed Action to 5,691 acres with a cumulative disturbance of 17,725 acres (3.7 percent). Successful reclamation of Alternative A would reduce its long-term disturbance to 3,417 acres with cumulative disturbance of 15,451 acres (3.2 percent).

In addition to cumulative impacts within the Moxa analysis area, other development projects have been or are being constructed, or are proposed for development within the general Moxa analysis area vicinity. These projects are discussed in greater detail under each resource discipline section in Chapter 4, Environmental Consequences.

Table 2-6. Existing Disturbance within the Moxa Analysis Area.

Disturbance Feature	Total Disturbance			Net Unreclaimed Disturbance		
	Area of Disturbance (acres)	Percent of Disturbance	Percent of Total Area in Moxa	Area of Disturbance (acres)	Percent of Disturbance	Percent of Total Area in Moxa
Urban	94	< 1	< 0.1	94	< 1	< 0.1
Railroad	1,550	6	0.3	1,550	13	0.3
Roads Public Roads Collector Roads Local Roads Resource Roads Unimproved Roads Subtotal	11,530	44	2.4	6,918	58	1.5
Pipelines	6,520	25	1.4	0	0	0
Drill/Well Sites	4,885	19	1.0	2,052	17	0.4
Facilities Sites	1,420	6	0.3	1,420	12	0.3
TOTAL	25,999	100	5.5	12,034	100	2.5

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CHAPTER 3

AFFECTED ENVIRONMENT

CHAPTER 3

AFFECTED ENVIRONMENT

3.0 INTRODUCTION

The Affected Environment chapter of this environmental impact statement (EIS) for the proposed Expanded Moxa Arch Area Natural Gas Development (Moxa) project discusses environmental, social, and economic factors as they currently exist within the Moxa analysis area. The material presented here has been guided by management issues identified by the Bureau of Land Management (BLM), Kemmerer Resource Area (KRA); public scoping; and by interdisciplinary field analysis of the area.

This proposal could potentially affect critical elements of the human environment as listed in BLM's National Environmental Policy Act (NEPA) Handbook H-1790-1 (USDI-BLM 1988). This EIS discusses potential effects of the project on range resources, air quality, transportation, geology/minerals/paleontology, soils, water, fisheries, vegetation and wetlands, wildlife, special status species, visual resources, noise, recreation, socioeconomics, cultural resources, and health and safety. The resources that are of concern in the analysis area include: air quality, cultural resources, floodplains, Native American religious concerns, special status species, wastes (hazardous or solid), water quality, and wetlands/riparian zones.The following resource elements, while critical, are not present in the analysis area and therefore will not be addressed further: prime and unique farmlands, wild and scenic rivers, areas of critical environmental concern, and wilderness areas.

3.1 RANGE RESOURCES AND OTHER LAND USES

3.1.1 Range Resources

The Moxa analysis area is comprised of 16 individual grazing allotments as shown in Table 3-1. Of the 16, only six of the allotments are located totally within the analysis area. Approximately 39 percent of the total acreage of the 16 allotments falls within the analysis area. The Granger Lease occupies the majority of the analysis area (56.2 percent) and the South Monument Allotment the least, representing less than one percent of the analysis area.

The livestock carrying capacity within the Moxa analysis area varies from eight acres per animal unit month (AUM) on the Carter and Opal allotments to 23 acres per AUM on the Austin Triangle Allotment. The approximate average throughout the analysis area is 13 acres per AUM. Many of the grazing allotments are stocked at rates less than currently permitted. Presently, the range is being utilized at 73 percent of total capacity. Most of the allotments are not fenced, although some are partially fenced to facilitate livestock management.

Approximately 55 percent of the AUMs within the analysis area are utilized by sheep grazing. Most sheep grazing (66 percent) is permitted annually from December 1 to April 30. The majority of the remaining sheep grazing is permitted to include spring/summer/fall grazing. Cattle are allowed to use about 43 percent of the AUMs. Most of the cattle use is also permitted during the spring/summer/fall period. Horse use is limited to one permit which occurs during the spring/summer/fall and comprises about two percent of the total AUMs. There are no feral horses found within the analysis area.

The BLM has identified livestock distribution, unauthorized grazing, and areas of accelerated soil erosion as range management problems within the analysis area.

3.1.2 Other Land Uses

Currently, 1,099 rights-of-way (ROWs) have been issued by the BLM on federal lands in the Moxa analysis area. The number, type, and size of ROW are summarized in Table 3-2. The percentage of total number of ROWs are shown in parenthesis. The percentage of the Moxa analysis area on federal lands under ROW authorization is shown by ROW type and size in acres in parenthesis. The acreage shown is the size of the authorized ROW area, *not* the amount of surface disturbance associated with ROW development.

Table 3-2 shows that if there were no overlaps in ROWs, approximately 23 percent of the Moxa analysis area located on federal surface would be under some type of use authorization. However, the actual acreage under ROWs is less than the 693 total shown above

Table 3-1. Approximate Acreage and Number of AUMs on Grazing Allotments, Expanded Moxa Arch Analysis Area.

Allotment Number	Total Acres	Acres in Moxa	Percent of Moxa	Total AUMs in Allotment[1]	AUMs in Moxa	Acres per AUM	Total AUM Reduction within Allotment[2]			
							Short-term		Long-term	
							AUM	%	AUM	%
Seedskadee (1112)	12,555	12,555	2.6	785	785	16	94	12	16	2
Slate Creek (1113)	271,170	57,474	12.1	12,293	2,612	22	431	4	72	<1
Cow Hollow (1301)	14,753	5,878	1.2	1,028	420	14	44	4	7	<1
Granger Lease (1302)	522,245	267,563	56.2	36,091	19,314	14	2006	6	334	<1
Lyman Cattle (1303 A & B)	32,263	22,207	4.7	2,245	1,586	14	166	7	28	1
Hassett (1305)	4,745	4,745	1.0	223	288	14	35	12	6	2
Carter (1306)	257,313	66,682	14.0	30,798	8,335	8	500	2	28	<1
Monument (1308)	8,361	3,592	0.7	744	327	11	27	4	4	<1
South Monument (1310)	223	223	<0.1	223	223	22	2	4	<1	<1
Austin Triangle (1312)	65,632	17,308	3.6	2,861	753	23	130	5	22	<1
Nelson Section (1321)	929	929	0.2	929	929	8	7	4	1	<1
Opal (1322)	3,863	640	4.7	500	80	8	5	4	1	<1
Nutria Allotment (1323)	1,070	1,070	4.7	100	100	11	5	4	1	1
Cottonwood Bench (1324)	25,059	15,023	3.1	2,258	1,366	11	112	5	5	<1
H.F. Allotment (1326)	375	375	0.1	36	36	10	3	8	<1	1
TOTAL	**1,220,556**	**476,261**	**99.80**	**91,179**	**37,154**	**--**	**3,567**	**4**	**580**	**0.6**

1 - Total AUMs include private, public, and State lands within the allotment.

2 - AUM reduction includes past, present, and Proposed Action.

Table 3-2. Rights-of-Way within the Moxa Analysis Area.

ROW Type	Number (percent)	Area and Percent of Analysis Area	Percent Federal Lands
Roads, etc.	295 (27%)	30,934 ac (20%)	12%
Pipelines	406 (37%)	46,468 ac (29%)	12%
Railroad Development	32 (3%)	2,942 ac (1%)	1%
Powerlines	210 (19%)	63,707 ac (40%)	25%
Telephone-Telegraph	116 (10%)	13,650 ac (9%)	5%
Water Development	9 (1%)	329 ac (<1%)	<1%
Other FLPMA[1]	31 (3%)	829 ac (<1%)	<1%
TOTAL	**1,099 (100%)**	**158,859 ac (100%)**	**61%**

1 - Refers to other ROWs issued under authorization of the Federal Land Policy and Management Act (FLPMA) of 1976.

because of overlaps in authorized area. In spite of the overlap, a considerable area is covered by ROWs. ROWs related to pipelines are the most abundant type, comprising about 37 percent of the total. Roads, powerlines, and telephone-telegraph are the next largest categories, making up 27 percent, 19 percent, and 10 percent, respectively.

Just under half (77,402 acres or 49 percent) of the acreage involved with ROWs falls into the roads and pipelines categories. Powerlines and telephone-telegraph facilities utilize 77,357 acres. The other types of ROWs involve relatively small areas.

3.2 AIR QUALITY/CLIMATE

3.2.1 Climate, Precipitation, and Winds

This section presents climatic information from Kemmerer and Green River, Wyoming, as the closest recording weather stations to the Moxa analysis area. Climatological data from Rock Springs are also presented because this station is the nearest station identified in Environmental Protection Agency's (EPA) SCRAM (Support Center of Air Models) database for use in the air quality analysis. Details on climate, precipitation, and winds are presented in the Soil and Water Resources Technical Report (ECOTONE 1995a).

The analysis area occurs in a continental dry, cold-temperate-boreal climate (Trewartha 1968), which is has limited rainfall and long, cold winters. The average annual temperatures are 42.7°F at Rawlins, 44.1°F at Rock Springs, and 39.3°F at Kemmerer. On the average, the hottest day occurs in July and the coldest in January. The average number of days per year with a minimum temperature at or below 32°F is approximately 225 days. The frost-free season lasts approximately two months.

Average precipitation is expected to range from 8 to 10 inches over the analysis area, with Green River, Kemmerer, and Rock Springs having averages of 7.71 inches, 8.94 inches, and 8.43 inches respectively. Precipitation is generally evenly distributed over the year with a peak in May and June. December and January being the two snowiest months (NOAA 1985). Due to the effect of ablation and snow drifting, a discontinuous snow cover is usually present during the winter. Snow drifts persist on north and northeast slopes. There is an annual precipitation deficit of approximately 11 inches.

The analysis area is subject to strong and gusty winds. During the winter months, strong winds are often accompanied by snow, which produces blizzard conditions and drifting snow. The frequency and strength of windy conditions greatly affects dispersion and transport of pollutants in the region. As can be seen from the Exhibit 3-1 wind rose, winds from the west through the southwest account for over 37 percent of the total. This wind pattern of prevailing westerly winds is fairly consistent throughout the year. The annual mean wind speed is a high 11.4 miles per hour (mph) (SCRAM 1994).

3.2.2 Air Quality

The air quality in the analysis area is generally very good, having low ambient background concentrations of pollutants. Table 3-3 shows representative background concentrations of total suspended particulate (TSP), SO_2, NO_2, and CO. The TSP, SO_2, and NO_2 data were collected during 1983 at the Chevron Phosphate Project, located 4.5 miles southeast of Rock Springs, Wyoming (Cote et al. 1984). These data are the most recent measurements made in a remote area near the proposed analysis area that reflect background concentrations unaffected by nearby localized pollutant emission sources. For remote areas, particulate matter less than ten microns in diameter (PM_{10}) and TSP concentrations will be nearly identical because much of the TSP fraction greater than 10 microns will have settled out. Background concentrations of CO were taken from representative data collected by Wyoming Department of Environmental Quality (WDEQ) and commercial operators which were summarized in USDI-BLM (1983a). Other criteria pollutants (lead and ozone) will be emitted from the proposed project in quantities so small that they will not be subject to air quality analysis under EPA or Wyoming regulation. Consequently, background concentrations of lead and ozone are not addressed in this section.

The total ambient concentrations of pollutants, including the existing background concentrations, must also stay below the EPA's National Ambient Air Quality Standards (NAAQS) and the WDEQ ambient standards. These pollutant concentration limits are shown in Table 3-3.

The Moxa analysis area currently meets all applicable ambient air quality standards and is deemed "attainment" for all criteria pollutants. The nearest "nonattainment" area is the trona industrial area approximately 10 miles west of the analysis area. The trona industrial area is deemed "nonattainment" for secondary PM_{10} ambient standards.

Although there are existing natural gas fired compressor units on well locations within the analysis area, the air quality impact from interaction between these compressor units and other Moxa well sites would be negligibly small due to the large separation distance between the sites.

3.3 TRANSPORTATION

The regional transportation system serving Lincoln, Sweetwater, and Uinta counties (including the Moxa analysis area) includes an established system of interstate, State and county roads. The Union Pacific Railroad maintains rail lines serving all three counties. Rail passenger service is provided to Rock Springs, Green River and Evanston. Commercial air service is available in Rock Springs and general aviation services are available at the Rock Springs, Evanston, Kemmerer, and Fort Bridger airports.

3.3.1 Highways Providing Access to the Analysis Area

Access to the analysis area is provided by a number of paved all-weather roads. Primary access from Green River and Rock Springs is from U.S. Interstate 80 (I-80) and U.S. Highway 30 (U.S. 39). Access from Evanston and the Bridger Valley is from I-80. Primary access from Kemmerer and Diamondville is from U.S. 30 and U.S. 189. Access to portions of the Moxa analysis area is also provided by Wyoming Secondary Highways WY 372, WY 240 and WY 374.

The service levels of the highways providing access to the analysis area are all well within tolerable standards (e.g., highway design, volumes of traffic, etc.) of the Wyoming Department of Transportation (WYDOT) (Rounds 1994). Sufficient unused capacity exists on the highways providing access to the analysis area that, with the exception of I-80, traffic volumes could nearly double before tolerable standards would be exceeded (Rounds 1994). Table 3-4 provides information on current traffic volumes for the highways identified.

3.3.2 Internal Circulation

The analysis area has been in various stages of development for the past 30 years; consequently, the internal transportation network is quite well developed. An extensive system of collector, local, and resource roads (defined in Section 2.2.2.2) currently exists. The

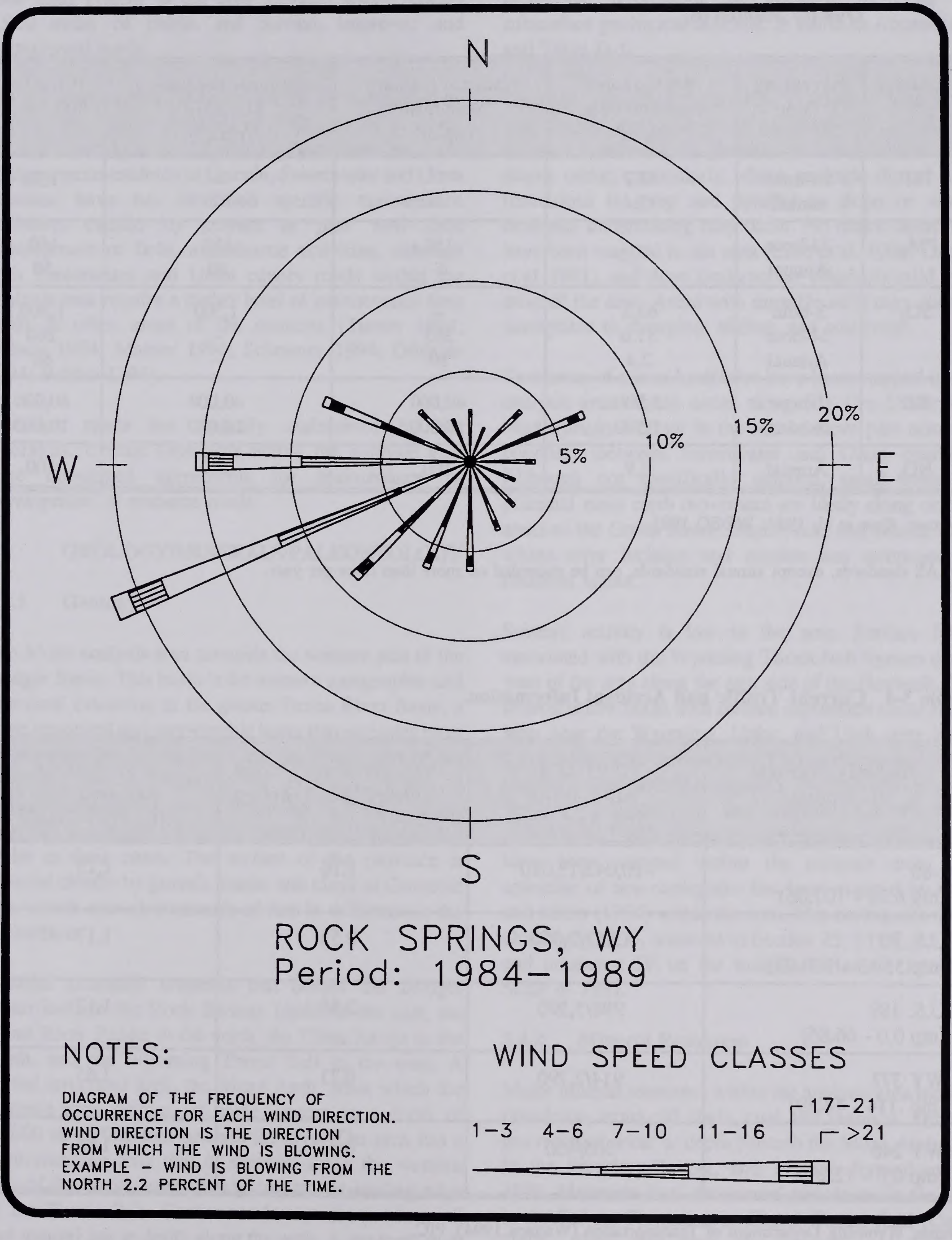

DIAGRAM OF THE FREQUENCY OF OCCURRENCE FOR EACH WIND DIRECTION. WIND DIRECTION IS THE DIRECTION FROM WHICH THE WIND IS BLOWING. EXAMPLE – WIND IS BLOWING FROM THE NORTH 2.2 PERCENT OF THE TIME.

Exhibit 3-1. Wind Direction Rose for the Moxa Arch Analysis Area.

Table 3-3. Representative Pollutant Background Concentrations and National and Wyoming Ambient Air Quality Standards.

Pollutant	Averaging Time	Background Concentration (µg/m^3)	National Primary Standard[1] (µg/m^3)	National Secondary Standard[1] (µg/m^3)	Wyoming Standard[1]
TSP	24-hour	44.7	--	--	150
	annual	12.4	--	--	--
PM$_{10}$	24-hour	--	150	150	150
	Annual	--	5	50	50
SO$_2$	3-hour	63.2	--	1,300	1,300
	24-hour	31.6	365	--	260
	Annual	2.4	80	--	60
CO	1-hour	3,500	40,000	40,000	40,000
	8-hour	1,500	10,000	10,000	10,000
NO$_2$	Annual	2.9	100	100	100

Sources: Cote et al. 1984; WDEQ 1993.

1 - All standards, except annual standards, can be exceeded no more than once per year.

Table 3-4. Current Traffic and Accident Information.

Highway Segment (mileposts)	1993 ADT All Vehicles Wtd. Avg./Peak	1993 Accidents/Million Vehicle Miles Traveled	1993 Average Accident Rate (by Hwy Class)
I-80 (mp 6.26 - 107.06)	10,042/15,010	1.16	1.15
U.S. 30 (mp 55.13 - 100.03)	1,852/2,070	0.58	1.17
U.S. 189 (mp 0.0 - 66.86)	998/5,590	0.58	1.17
WY 372 (mp .114 - 48.59)	914/2,790	0.71	1.65
WY 240 (mp 0.0 - 12.29)	305/400	0.81	1.65

Source: Wyoming Department of Transportation (Wallace 1994), PIC.

total road system in the area includes approximately 1,900 miles of public and private, improved and unimproved roads.

County roads within the analysis area are maintained by the road and bridge department of the county in which the roads are located. County engineers and road and bridge superintendents in Lincoln, Sweetwater and Uinta counties have not identified specific maintenance problems caused by current or past well field development or field maintenance activities, although both Sweetwater and Uinta county roads within the analysis area require a higher level of maintenance than roads in other areas of the counties (Turner 1994; Nelson 1994; Malner 1994; Schramm 1994; Gibbons 1994; Brisko 1994).

Resource roads are typically maintained by the Operators. Certain Operators within the analysis area have developed agreements for maintenance of development of resource roads.

3.4 GEOLOGY/MINERALS/PALEONTOLOGY

3.4.1 Geology

The Moxa analysis area occupies the western part of the Bridger Basin. This basin is the western topographic and structural extension of the greater Green River Basin, a large structural and topographic basin that occupies most of southwestern Wyoming. Both basins are part of the Wyoming Basin Physiographic Province, which is characterized by large intermontane structural basins bounded by mountain uplifts preserving Precambrian rocks at their cores. The surface of the province is covered chiefly by gravels, sands, and clays of Cenozoic age, which exceed thousands of feet in thickness in the subsurface.

General structural elements that border the Bridger Basin include the Rock Springs Uplift to the east, the Wind River Range to the north, the Uinta Range to the south, and the Wyoming Thrust Belt to the west. A buried structural arch, the Moxa Arch, from which the analysis area derives its name, occurs at a depth of 11,000 to 13,000 feet beneath the area. The arch has a north-trending axis that is situated along the western side of the basin, immediately east of the leading edge of the Thrust Belt. Cretaceous formations produce oil and natural gas at depth along the arch. A geologic map of the Moxa analysis area is shown as Exhibit 3-2. Additional information on geology, including the subsurface geological deposits, is found in Appendix D and Table D-1.

Potential geologic hazards include landslides, subsidence, and known or suspected active faults. Landslide potential is greatest in areas where steep slopes occur, particularly where geologic dip of rock formations is steep and parallel to slope or where erosional undercutting may occur. No major landslides have been mapped in the area (Case et al. 1991; Larsen et al. 1991), and slope gradients are relatively mild over most of the area. Areas with unstable soils may also be susceptible to slumping, sliding, and soil creep.

Two areas of minor landslides have been mapped in the analysis area. These occur along Big Dry Creek and Mud Springs Hollow in the southeastern part near the boundary between Sweetwater and Uinta counties. Although not specifically mapped, small areas of potential mass earth movement are likely along certain areas of the Green River, Hams Fork, and Blacks Fork where river incision and erosion has steepened or undercut banks.

Seismic activity is low in the area. Surface faults associated with the Wyoming Thrust Belt System occur west of the area along the east side of the Hogback. The nearest active faults with surface expression occur to the west near the Wyoming, Idaho, and Utah state lines. The leading edge of the Darby Thrust, the nearest major fault with near surface expression, occurs buried beneath Tertiary sediments a few miles west of Opal (Blackstone 1980). No faults with Quaternary movement have been mapped within the analysis area. The epicenter of one earthquake has been mapped by Case and others (1994) within the area. This earthquake dated October 3, 1956, occurred in Section 25, T18N, R112W and measured IV on the modified Mercalli Intensity Scale of 1931.

3.4.2 Mineral Resources

Major mineral resources within the analysis area include petroleum, trona, oil shale, coal and uranium. Oil and gas reserves occur at depth beneath the Moxa Arch area in the Frontier, Dakota, and Morgan formations. In 1946, Mountain Fuel discovered petroleum in the area in the Dakota Formation in Church Buttes field (Curry 1992). Since that time, the Frontier and Morgan formations have also proven productive in that field and in several other fields that have been discovered and developed (DeBruin and Boyd 1991): Bruff, Cow Hollow, Emigrant Springs, Fabian Ditch, Moxa, Opal, Pipeline Crossing, Sevenmile Gulch, Shute Creek, Storm Shelter, Verne, Whiskey Butte, Wild Hare Gulch, Wilson Ranch, and Zeiglers Wash. Currently about 321 wells and 390 miles of roads and 340 miles of pipelines associated with the natural gas production occur in these areas (USDI-BLM 1991a).

The world's largest known deposit of trona, an anhydrous sodium carbonate mineral that can be refined into soda ash, occurs in southwestern Wyoming. The U.S. Geological Survey (USGS) estimates that 42 beds within the Wilkins Peak Member of the Green River Formation contain nearly 82 billion tons of trona and 53 billion tons of mixed trona and halite (Harris et al. 1985). Most of these deposits occur east of the area, but some extend in the subsurface into the southeastern part area (USDI-BLM 1979, 1985a).

Oil shale deposits are preserved in the Tipton Shale, Wilkins Peak, and Laney Members of the Green River Formation that underlie much of the area. Significant deposits of oil shale do not occur at the surface, and those at depth are not considered suitable for mining with current technology (USDI-BLM 1985a).

Coal is likely present in the subsurface beneath the area in Tertiary and Cretaceous age formations (Wasatch, Fort Union, and Lance) but would occur at depths making current extraction uneconomic (Jones 1991). There may also be potential for coal methane production beneath the northern part of the area (USDI-BLM 1991a).

Construction materials occur at widely-spaced locations in the area. Recent alluvial sands and gravels occur along the Green, Hams Fork, and Blacks Fork rivers and along Sevenmile Gulch, Dry Muddy Creek, and Shute Creek. Terrace sands and gravels of Quaternary age occur in the eastern part of the area, along the south side of the Hams Fork. Construction grade wind-blown sand occurs sporadically throughout the area and is most notable south of Fontenelle in the Opal Dunes and Church Buttes areas (Harris and Meyer 1986). Exhibit 3-3 shows the mineral activity in the Moxa analysis area and southwest Wyoming.

3.4.3 Paleontology

According to Wyoming BLM guidelines (IB WY-93-371), paleontologic resources include the remains or traces of any prehistoric organism which has been preserved by natural processes in the Earth's crust. While of biological origin, energy minerals such as coal, oil shale, lignite, bitumen, asphaltum, and tar sands as well as some industrial minerals such as phosphate, limestone, diatomaceous earth, and coquina are not considered fossils in themselves. However, fossils of scientific interest may occur within or in association with such materials. Fossils of scientific interest include those fossils of particular interest to professional paleontologists and educators. Vertebrate fossils are always considered of scientific interest; other kinds of fossils may be placed in this category by the State Director, and District or Area Managers, in consultation with BLM staff paleontologists or other experts. Paleontologic resources are older than recorded history and/or greater than 5,000 years old (SVP 1995).

Paleontologic resources within sedimentary deposits in the analysis area record the history of animal and plant life in Wyoming during part of the Cenozoic Era. The record represented by Cenozoic age deposits spans about 25 million years and includes parts of the early Tertiary and Quaternary Periods.

Geologic mapping documents at least five different geologic deposits that crop out in the analysis area. These include, from youngest to oldest: 1) alluvium and colluvium of Quaternary age; 2) dune sand and loess of Quaternary age; 3) gravel, pediment, and fan deposits of Quaternary age; 4) Bridger Formation of middle Eocene age, including deposits informally referred to as of Bridger A and B; and 5) Green River Formation of middle Eocene age, including the Laney Member (See Exhibit 3-2).

The Holocene deposits are probably, for the most part, too young to contain fossils. The Bridger Formation and Laney Member of the Green River Formation have a high paleontologic potential. Fossils from these units are world renown for their preservation and specimens from them are housed in most major museums in the world. Information on the geologic deposits exposed in the analysis area and their paleontologic potential is summarized in Table D-2, Appendix D. Geographic distribution of these deposits is shown in Exhibit 3-2. Additional information on geologic deposits in unnamed

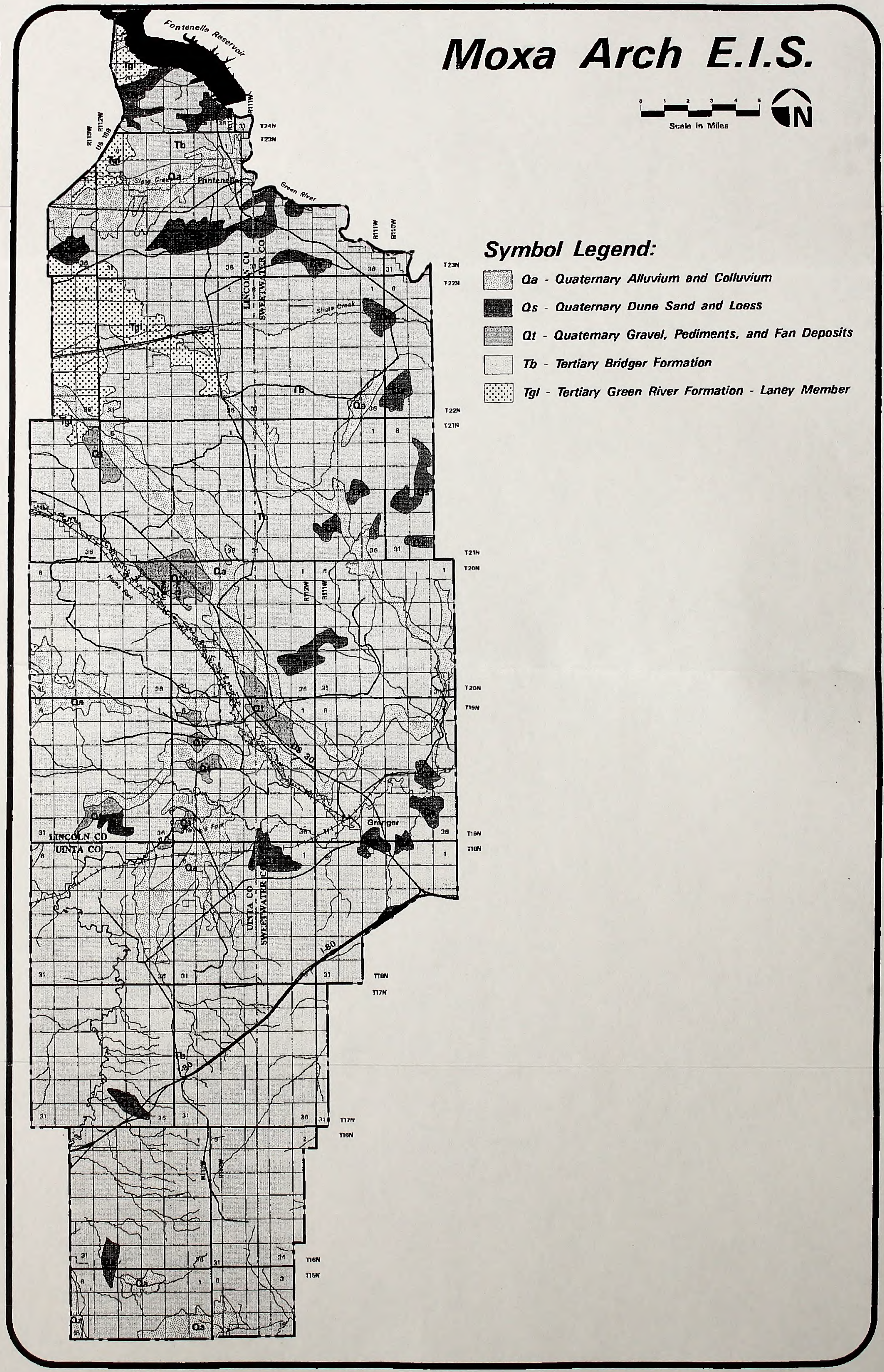

Exhibit 3-2. Geologic Map of the Moxa Analysis Area.

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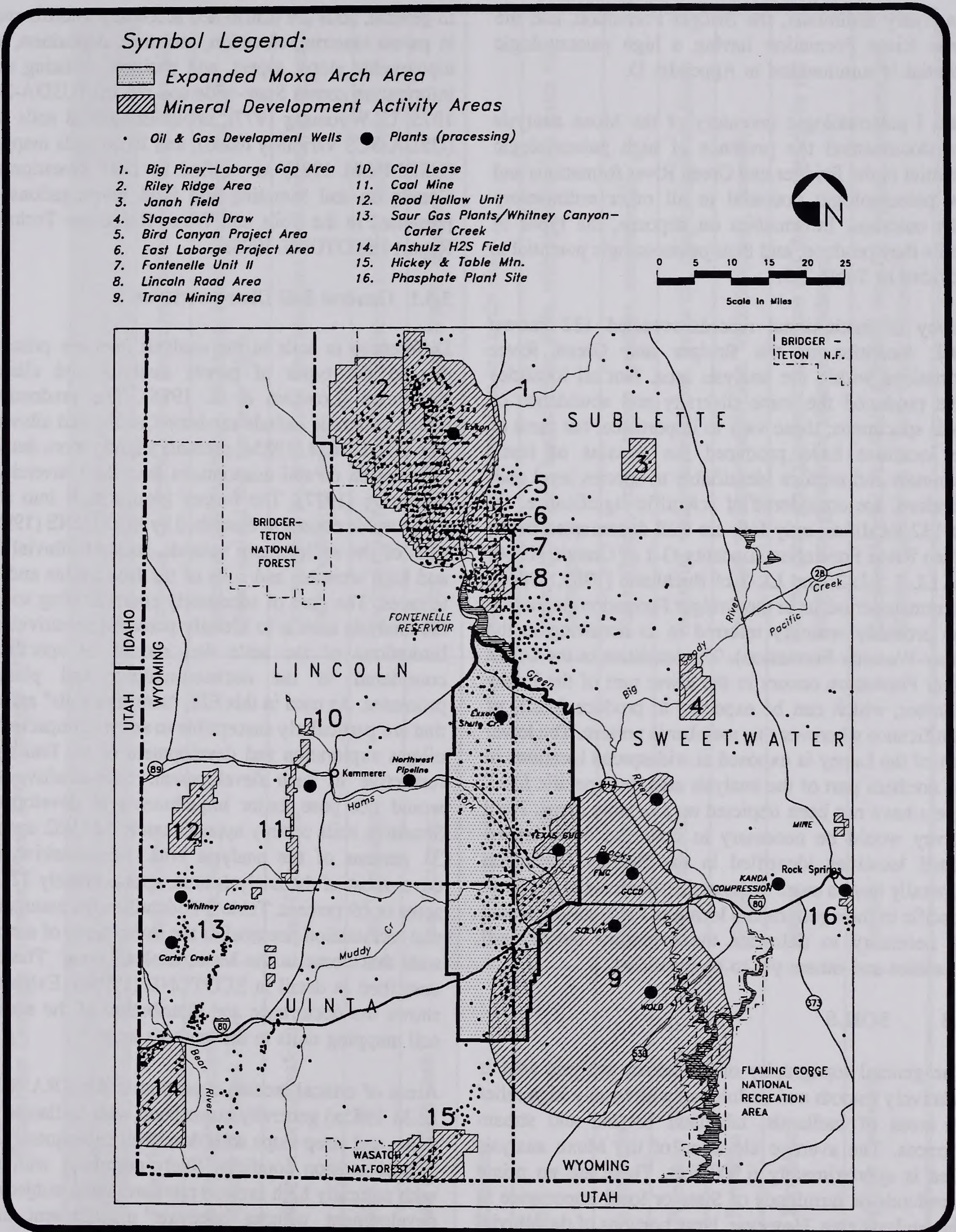

Exhibit 3-3. Mineral Development Activity in the Moxa Analysis Area (1991 Data--BLM Wyoming State Office).

Quaternary sediments, the Bridger Formation, and the Green River Formation having a high paleontologic potential is summarized in Appendix D.

Class I paleontologic inventory of the Moxa analysis area documented the presence of high paleontologic potential in the Bridger and Green River formations and low paleontologic potential in all other sedimentary units outcrops. Information on deposits, the types of fossils they produce, and their paleontologic potential is provided in Table 3-5.

Survey of institutional records revealed 132 known fossil localities in the Bridger and Green River formations within the analysis area. Not all localities have produced the same diversity and abundance of fossil specimens; these vary in importance, but most of the localities have produced the remains of fossil mammals and reptiles identifiable to species level and, therefore, are considered of scientific significance. Of the 132 localities, only four are well documented in the Green River Formation (Locality G-1 of Grande [1984] and LL-1, LL-2, and LL-3 of Buchheim [1981, 1984]), the remainder occur in the Bridger Formation (including one probably wrongly referred to as occurring in the upper Wasatch Formation). The localities in the Green River Formation occurs in the lower part of the Laney Member, which can be expected to produce fossils of significance wherever this member is present. The lower part of the Laney is exposed at widespread locations in the northern part of the analysis area, but specific fossil layers have not been depicted on available maps. Field survey would be necessary to delineate these layers. Fossil localities identified in the Bridger Formation generally have a more disjunct distribution and are more specific in their geographic location. Field survey would be necessary to delineate the extent of these fossil localities and others yet to be identified.

3.5 SOILS

The general topography of the Moxa analysis area is relatively smooth and undulating with locally high relief in areas of badlands, tableland breaks, and stream terraces. The average elevation of the Moxa analysis area is approximately 6,500 feet. There are no prime farmlands or farmlands of State or local importance in the analysis area. However, large portions of the alluvial bottomlands of major perennial streams are irrigated and cropped.

In general, soils are distributed according to differences in parent material, elevation, moisture, deposition, and topographic slope, aspect, and position. Existing soils information comes State-wide soil reports (USDA-SCS 1975; U. Wyoming 1977), unpublished SCS soils data (USDA-SCS variously dated), and BLM soils mapping (USDI-BLM 1985) as verified by field investigation. Details on soil sampling and field investigations are presented in the Soils and Water Resources Technical Report (ECOTONE 1995a).

3.5.1 General Soil Characteristics

Differences in soils in the analysis area are primarily due to the types of parent material and climatic conditions (Lowham et al. 1985). The predominant parent materials include sandstone, shale, and alluvium. The USDI-BLM (1985a) presents slightly more detailed information on soil associations than the University of Wyoming (1977). The former groups soils into three geomorphic classes as described by ECOTONE (1995a): soils of the sedimentary uplands, soils of alluvial fans and high terraces, and soils of the floodplains and low terraces. The goal of adequately characterizing soils in the analysis area is to identify potential sensitivities or limitations of the soils that should be specifically considered in the decision-making and planning processes. As used in this EIS, "sensitive soils" are soils that are particularly susceptible to adverse impacts from oil/gas exploration and development or are limiting or restrictive to such development. Non-sensitive soils would not pose major impediments to development. Sensitive soils occupy approximately 148,962 acres, or 31 percent of the analysis area. Non-sensitive soils cover most of the analysis area, approximately 327,299 acres or 69 percent. Table 3-6 identifies the nature, area, and reclamation potential of the seven types of sensitive soils that occur in the Moxa analysis area. These are described in detail in ECOTONE (1995a). Exhibit 3-4 shows the occurrence and distribution of the sensitive soil mapping units in the analysis area.

Areas of critical erosion condition in the KRA (USDI-BLM 1985a) generally correspond with badlands, sand dune, and steep slope soils described subsequently. The critical erosion condition likely correlates with areas with naturally high erosion rates and areas subjected to development without adequate management and/or restrictions.

Table 3-5. Subsurface Geologic Deposits, Moxa Arch Analysis Area.

Geologic Deposit	Geologic Age	Environment/Lithology
Wasatch Formation	Early Eocene	Terrestrial, variegated to drab mudstones, sandstones, shales, and coals.
Fort Union Formation (includes Chappo Member of Hoback Fm)	Paleocene	Terrestrial, drab mudstone, sandstone, shales, limestones, and coals, coarser grained near the basin edges.
Lance Formation (or equivalent)	Late Cretaceous	Terrestrial/marine, brown and gray sandstone, shale and mudstone, coals, and carbonaceous shales.
Mesa Verde Group	Late Cretaceous	Marine/shoreline, light-colored sandstone and gray sandy shale
Baxter Shale (=Hilliard Shale)	Late Cretaceous	Marine, gray shale containing gray, brown sandstones
Frontier Formation	Late Cretaceous	Marine/deltaic, gray sandstone and sandy shale
Aspen Shale	Late Cretaceous	Marine, silver-gray, hard siliceous shale, with abundant fish scales and bentonites
Bear River Formation	Early Cretaceous	Marine/deltaic, gray to brown sandstone, conglomeratic
Cloverly Formation (=Gannett Group)	Early Cretaceous	Terrestrial, variegated mudstone, bentonitic, conglomeratic sandstone
Morrison Formation	Jurassic	Terrestrial, variegated mudstones, white sandstone, bentonite
Sundance Formation	Jurassic	Marine, green-gray glauconitic sandstone and shale, underlain by red and gray non-glauconitic shale and sandstone
Gypsum Springs Formation	Jurassic	Restricted Marine, red shale, dolomite, massive gypsum, limestone and siltstone. Equivalent to Twin Creek Limestone

Table 3-5. Subsurface Geologic Deposits, Moxa Arch Analysis Area, Continued.

Geologic Deposit	Geologic Age	Environment/Lithology
Nugget Sandstone	Triassic to Jurassic	Eolian, gray to red, massive to cross-bedded sandstone
Chugwater Formation	Triassic	Terrestrial/mudflat, red shale and siltstone, sandstone
Ankareh Formation	Triassic	Marginal Marine. deep red maroon and yellow to orange shale, sandstone and siltstone
Thaynes Limestone	Triassic	Marine, in ascending order, lower limestone, lower black limestone, tan silty limestone, upper black limestone, sandstone, and limestone, Portneuf and Timothy Limestones
Woodside Shale	Triassic	Marine, red to maroon shaley non-fossiliferous limestone
Dinwoody Formation	Permian to Triassic	Marine, gray to olive dolomitic siltstone (Dinwoody); red sandstone and siltstone, gypsum, halite, purple to white dolomite and limestone (Goose Egg)
Phosphoria Formation	Permian	Marine, dark to light gray, green to black, glauconitic shale and sandstone, phosphatic sandstone and dolomite (Phosphoria)
Tensleep Sandstone	Pennsylvanian	Eolian, white to gray sandstone with limestone and dolomite
Weber Sandstone	Pennsylvanian	Eolian, white to buff, quartz-rich interbedded with thin limestones and dolomites, equal in part to Tensleep Sandstone.
Morgan Formation	Pennsylvanian	Marine, cherty carbonates, red shales, equivalent to Amsden in part.
Amsden Formation	Mississippian to Pennsylvanian	Marine, red and green shale and dolomite, persistent red to brown sandstone at base
Madison Limestone	Mississippian	Marine, blue-gray massive limestone and dolomite

Table 3-5. Subsurface Geologic Deposits, Moxa Arch Analysis Area, Continued.

Geologic Deposit	Geologic Age	Environment/Lithology
Darby Formation	Devonian	Terrestrial, dark dolomite, interbedded with shale, mudstone and sandstone
Bighorn Dolomite	Ordovician	Marine, light-gray massive dolomite
Gallatin Limestone (or Group)	Cambrian	Marine, glauconitic flat-pebble conglomerate, calcareous shale, and limestone
Gros Ventre Formation (or Group)	Cambrian	Marine, glauconitic red sandstone, green and red shale, dark-gray massive limestone, green shales and thin limestones, and flat-pebble conglomerates.
Flathead Sandstone	Cambrian	Marine/shoreline, red, banded, quartzose sandstone
unnamed metamorphic rocks	Precambrian	Igneous/metamorphic, granitic and/or intrusive

Source: Love and Christiansen (1985); Love, Christiansen and Ver Ploeg (1993).

Table 3-6. Area of Sensitive and Non-sensitive Soils within the Moxa Analysis Area.

Category	Nature of Sensitivity	Area (Acres)	Percent of Total Area	Reclamation Potential
Non-Sensitive Soils	N/A	327,299	68.6	fair to good, some areas of poor to fair
Sensitive Soils				
Red sodic & carbonatic soils	low bearing strength, high sodium/carbonate levels, heavy texture, high erosion, instability	0	0.0	poor
Sand dune soils	very high erosion, non-cohesive texture	61,346	12.9	limited
Steep Slopes[1]	high erosion, slope instability, high coarse fragment content	2,283	0.5	poor
Badland soils	heavy texture, high erosion, slope instability, high visibility, high sodium	31,217	6.6	poor
Saline/sodic bottomland soils	heavy texture, instability, high water table, high erosion, poor bearing strengths	37,011	7.8	poor
Wetland soils	heavy texture, high moisture content, high water table, low bearing strengths, frequent flooding and/or inundation, association with surface water	4,773	1.0	fair to excellent
Floodplain soils	frequent flooding and/or inundation, high water table, association with surface water	12,332	2.9	fair to good

Cumulative Category	Acres	Percent Total
Sensitive Soils	148,962	31.4
Non-sensitive Soils	327,299	68.6
TOTAL	**476,261**	**100.0**

1 - Steep slopes are greater than 25 percent and over 200 feet in length.

3.5.2 Existing Soil Disturbance

The Moxa analysis area is not in a pristine condition. As discussed in Section 2.6.2 of Chapter 2, approximately 25,999 acres or 5.5 percent of the 476,261-acre analysis area has been subjected to numerous disturbance activities (e.g., transportation facilities, urbanization, mining, oil and gas development, and livestock grazing). The effects of the disturbance are primarily erosion and sedimentation, loss of topsoil, and reduction in soil productivity.

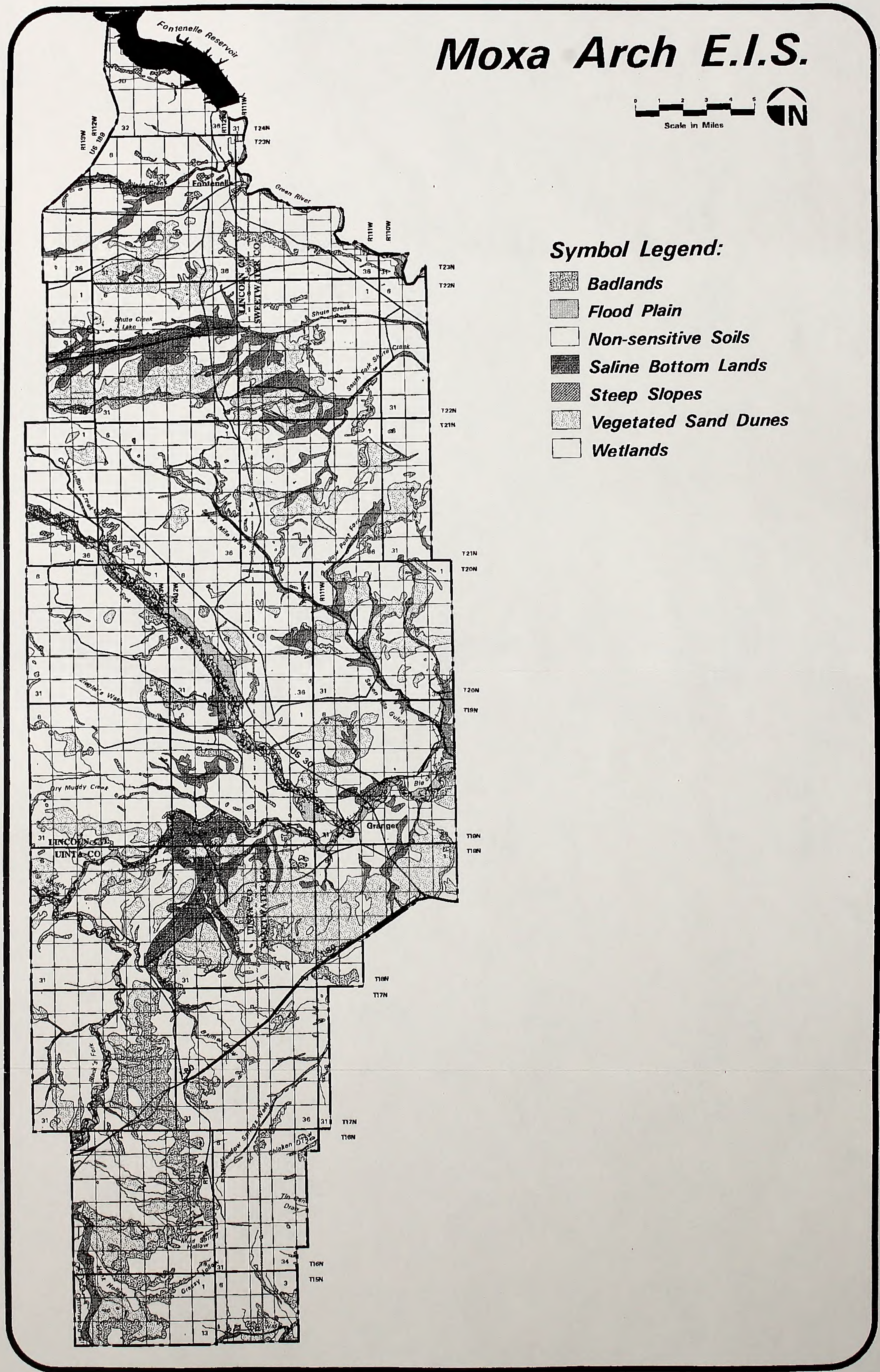

Exhibit 3-4. Occurrence and Distribution of Sensitive Soil Mapping Units in the Moxa Analysis Area.

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Approximately 13,965 of the 25,999 acres are in various stages of reclamation to predisturbance condition. The residual disturbance areas, 12,034 acres or 2.8 percent of the analysis area, are currently being used and are not subject to reclamation at this time. Residual disturbances within specific hydrologic units range from less than 0.1 percent to 4.6 percent (see Table 4-8 in Section 4.5 of Chapter 4). These percentages are relatively high and indicate that disturbances are not uniformly distributed across the analysis area.

In general, reclamation has been effectively applied and has been successful in establishing desirable perennial species. There are locations with poor reclamation, but these are generally of limited areal extent. Causes of poor reclamation include failure to implement appropriate reclamation efforts necessary for edaphic conditions (e.g., erosion control, seed mix, etc.): seasonal restrictions (i.e., disturbance occurred during summer, with reclamation to occur in fall); and failure to prevent/control weed infestations. Erosion was not observed to hinder reclamation success but could do so without implementation of adequate measures. Evaluation of reclamation success data is presented in greater detail in the Soils and Water Resources Technical Report (ECOTONE 1995a).

The Unified Soil Loss Equation (USLE) (Wischmeier and Smith 1965; Israelsen et al. 1980) as modified for use on wild lands (USDA-FS 1980) was applied to estimate natural baseline erosion rates for the analysis area (ECOTONE 1995a). An approximate rate of 0.7 t/ac/yr (or 333,400 t/yr) was assessed for the analysis area. This is a general approximation and should only be interpreted as an indicator of relative magnitude as opposed to an absolute magnitude. Existing disturbance has accelerated soil erosion over baseline or natural rates. Approximate erosion from the 25,999 acres of disturbance could be as high as five t/ac/yr, or 130,000 t/yr. Thus, total erosion could be as high as 463,400 t/yr, including natural baseline erosion and increased erosion due to existing disturbance.

3.6 WATER RESOURCES

Surface water resources include numerous intermittent and ephemeral streams, several perennial streams, livestock ponds, small detention reservoirs, and seeps and springs. Groundwater resources include free water contained within relatively shallow aquifers that are or could be utilized for culinary, agricultural, and industrial purposes. Therefore, the occurrence and distribution of water resources in the analysis area depends on climate (Section 3.2.1) and structural geology (Section 3.4.1). Additional detail on surface and groundwater resources is presented in the Soils and Water Resources Technical Report (ECOTONE 1995a).

3.6.1 Surface Water

3.6.1.1 Quantity

Surface water is relatively rare or infrequent within the analysis area. Many of the surface water features including streams, lakes, springs, and wells are shown in Exhibit 3-5. Numerous stream channels occur within the analysis area but the vast majority of the channels are ephemeral. Table 3-7 lists the major named channels in the Moxa analysis area, their WDEQ flow class, and drainage basin. Wells have been drilled in the analysis area to develop drinking water for livestock. Many of these wells support small perennial and intermittent impoundments. Oil and gas development has also involved development of wells that discharge perennial water into impoundments for livestock.

Surface drainage within the Moxa analysis area is generally towards the Green River, which occurs to the east and outside the analysis area. The perennial streams generally have a lower channel gradient than the intermittent and ephemeral streams. Sinuosity of channels is greater for perennial streams as are meander length and amplitude. Most channels exhibit steep or gullied banks, actively sloughing cut banks, channel widening, and/or lateral migration of channels across alluvial bottomlands. Such channel adjustments are typical of streams in the mountain West, occur for various reasons such as heavy rangeland vegetation utilization and a slight increase in the incidence of high peak flows (Dunne and Leopold 1978; Leopold et al. 1964; Leopold 1989), and expose alluvial fines to entrainment and transport in surface waters. Thus, many flows within ephemeral and intermittent streams are highly turbid.

The Wyoming Game and Fish Department (WGFD 1991) classifies most of the streams within the analysis area as Class 5 streams (incapable of supporting fish). The Green River located just outside of the analysis area is a Class 2 stream (very good trout waters - fisheries of State-wide importance). Portions of Blacks Fork, portions of Smiths Fork, and portions of Cottonwood

Table 3-7. Named Surface Water Bodies in the Moxa Analysis Area, Hydrologic Regime, and WDEQ Class.[1]

Streams	Hydrologic Regime	WDEQ Class	Streams	Hydrologic Regime	WDEQ Class
Shute Creek	E-I	4	Telephone Draw	E	4
Green River	P	2	Meadow Springs Wash	I	4
Slate Creek	I-P	2	Chicken Draw	E	4
South Fork Shute Creek	E-I	4	Blumel Draw	E	3
Sevenmile Gulch	E-I	3	Jackknife Draw	E	3
West Otterson Wash	E	4	Mud Spring Hollow	E	3
Yellow Point Fork, Sevenmile Gulch	E	4	Hank Hollow	E	3
Cow Hollow Creek	E	4	Grassy Hollow	E	3
Hams Fork	P	2	Cottonwood Creek	I	3
Zieglers Wash	E	4	Dry Wash	--	4
Blacks Fork	P	3	Dry Creek	E	4
Big Muddy Creek	P	2	Butcher Knife Draw	E	4
Dry Muddy Creek	E-I	4	Tin Can Draw	E	4
Caterpillar Draw	E-I	3	Porter Hollow	E	4
Bruff Draw	E	--	Smiths Fork	E	2
Springs	**Hydrologic Regime**	**WDEQ Class**	**Springs**	**Hydrologic Regime**	**WDEQ Class**
Meadow Springs	I	2	Carter Springs	I	—
Butcher Knife Spring	I	--	Shurtliff Spring	I	--
Lakes	**Hydrologic Regime**	**WDEQ Class**	**Lakes**	**Hydrologic Regime**	**WDEQ Class**
Fontenelle Reservoir	P	2	Shute Creek Lake	E	--
Irrigation Ditches	**Hydrologic Regime**	**WDEQ Class**	**Irrigation Ditches**	**Hydrologic Regime**	**WDEQ Class**
Old Mexican Ditch	—	—	Chrisman Ditch No. 1	—	—
Nutria Ditch	—	—	Winslow Hallock and Capen Ditch	—	—
Fabian Ditch	--	--	Fabian and Tyler Ditch	--	--
Moxa Ditch	--	—	Philbrick and Johnson Ditch	—	—
Moore and Bagley Ditch	--	--	Zieglers Ditch	--	--

1 - Sources: Lowham et al. 1985; E = ephemeral, I = intermittent, P = perennial; see the Glossary for the WDEQ classifications.

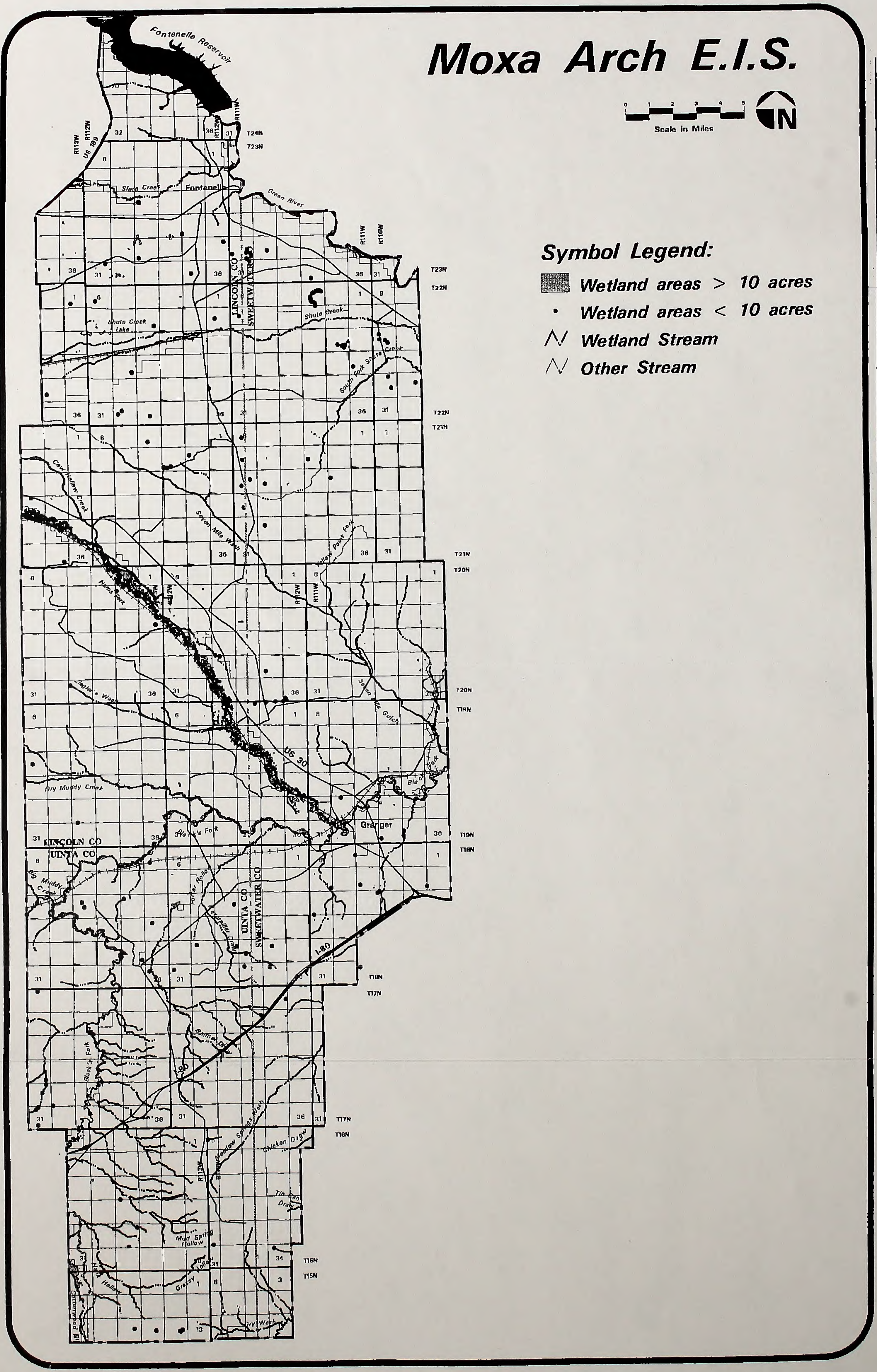

Exhibit 3-5. Surface Water Bodies, Waters of the U.S., and Wetlands in the Moxa Analysis Area.

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Creek are Class 3 (important trout waters - fisheries of regional importance). The lower Blacks Fork, lower Cottonwood Creek, and portions of Smiths Fork are Class 4 stream (low production trout waters - fisheries frequently of local importance but generally incapable of sustaining substantial fishing pressure) (WGFD 1991).

Based on a stream channel analysis (ECOTONE 1995a), streams in the analysis area are very sensitive to disturbance in the channel environment and to increases in surface runoff and/or tributary inflow and sediment. Recovery potential of the streams is very poor to good depending on stream type. All streams have a moderate to very high sediment supply. Streambank erosion potential is high to very high. The potential for streamside vegetation protecting these channel types was moderate to very high.

The four major watersheds identified by the USDI-BLM (1994b) in the Moxa analysis area are 1) Upper Green River (#14040101), 2) Upper Green River-Slate Creek (#14040103), 3) Blacks Fork (#14040107), and 4) Muddy Creek (#14040108). The area produces less than one inch runoff per year (Lowham et al. 1985); the mean annual runoff, or watershed yield, is less than 0.5 in/year, or about six percent of the total annual precipitation (Wyoming Water Research Center 1990). Surface runoff may be of insufficient quantity and frequency to maintain an active stream channel. Most channels identified on USGS topographic maps are vegetated swales. A channel may intergrade between an active channel and a vegetated swale. Similarly, some of the larger ephemeral to intermittent and intermittent streams may exhibit variable flow from one section to another. Springs contribute a small amount of inflow to drainages. However, due to evaporation, transpiration, seepage, and freeze-up, the inflow from springs generally extends only a short way downstream from the source.There are no continuously recording USGS stream gages in the analysis area. The gage on Blacks Fork near Little America (#09224700), located approximately 10 miles east of the analysis area, is likely most representative of perennial streams in the analysis area. For the period of water years 1962 through 1992, the annual mean discharge is 333 cubic feet per second (cfs), maximum instantaneous peak discharge is 9,980 cfs, and minimum flow is no flow. Based on data at this gage, peak flows occur in early to mid-June, the recessional limb lasts through July, baseflows dominate from August through February, and the rising limb lasts from March through May and into early June. Discharges in the Blacks Fork are significantly modified by on- and off-channel storage reservoirs for various industries, and for irrigation diversions. Diversions will typically deplete the river during the dry portion of the year such as in late August.

In addition, the BLM has measured stream flow at several locations on ephemeral and intermittent channels in the Moxa analysis area. The data does not adequately indicate the frequency, duration, or magnitude of flows that occur in the intermittent and ephemeral drainages but does indicate the high variability in flows over time.

Existing development in the Moxa analysis area has disturbed approximately 25,999 acres or 5.5 percent of the analysis area. The relatively sparse vegetal cover is nominally effective at detaining excess surface water. As such, the existing level of disturbance has likely not resulted in a measurable increase in surface runoff and stream inflow rates given the distal location of most disturbances from stream channels, high evaporation rates, and character of the native soils, including relatively high infiltration rates.

Major flood zones within the Moxa analysis area are associated with the Green River, Blacks Fork, Hams Fork, Smiths Fork, Cottonwood Wash, Muddy Creek, and Sevenmile Wash. In addition, several of the larger ephemeral/intermittent washes within the analysis area also have floodplains associated with their channels. These areas are shown in Exhibit 3-4. Flooding in ephemeral and intermittent streams generally occurs in response to high intensity, localized storms. Flooding in perennial streams occurs in response to both high intensity, localized storms and rain-on-snow events. Such events cause most of the floodwater damage, surface erosion, arroyo formation, and sediment deposition in arid and semi-arid environments (Branson et al. 1981). Many roads and oil and gas development facilities have been constructed in or immediately adjacent to such areas subject to the infrequent flooding.

3.6.1.2 Quality

In semiarid regions, surface waters typically have a relatively high concentration of dissolved-solids. Surface water in the Moxa analysis area is not suitable for culinary use and has certain restrictions for use in industry and livestock and wildlife due to high turbidity, suspended solids, dissolved solids, and salinity. No known significant point sources of pollution have been documented. The primary non-point pollution sources are natural or geologic erosion and leaching of dissolved solids.

Table 3-8 summarizes surface water quality characteristics of sources in or near the analysis area. In general, perennial surface water bodies provide higher quality water than intermittent and/or ephemeral water bodies. Water quality deteriorates with increasing watershed area due to increased salinity contributions from eroded soil (USDI-BLM 1979) and to the increase in relative concentrations of sodium, sulfate, or both (DeLong 1986). Unusually intense storms can cause saline runoff, but since streams are primarily intermittent and ephemeral and such storms are localized, runoff does not have a significant effect on major drainages (DeLong 1986). There is a concern for phosphorous loading of the Green River. Such loading can cause eutrophication of Flaming Gorge Reservoir as sediments with adsorbed phosphorous are removed from the water upon entering the reservoir (USDI-BLM 1985a, DeLong 1986). A sizeable total phosphorous load enters the Flaming Gorge Reservoir from the Blacks Fork drainage (Lowham et al. 1985).

Grazing, oil and gas and other mining developments, and poor road construction may further increase the naturally high erosion rates described in the Soils Section 3.5. However, most of this disturbance is away from stream channels. Information developed by the USDI-BLM (1994b) pursuant to the Colorado River Basin Salinity Control Initiative suggests that watersheds in the Moxa analysis area may produce sediment at an approximate rate of 0.29 acre-feet (ac-ft) per square mile per year. This is a general approximation and should only be interpreted as an indicator of relative magnitude as opposed to an absolute magnitude. This volume equates to approximately 0.005 inches/yr of sediment production, or 1.1 tons/ac/yr. In contrast, the average unit sediment yield for the Blacks Fork watershed is 1.49 tons/ac/yr (USDI-BLM 1979). Based on Section 3.5.2, baseline erosion could be as high as 0.7 tons/ac/yr, and accelerated erosion from soil disturbance could be as high as five tons/ac/yr. Baseline (333,383 tons/yr) and accelerated erosion (130,000 tons/yr) combined could be as high as 463,400 tons/yr. These estimates relate to movement of soil on-site. Transport efficiencies are relatively low in the Moxa analysis area (ten percent), and very little of the eroded material (approximately 46,340 tons/yr) is likely transported to and discharged into streams. Most sediment transported in stream channels arises from in-channel erosion.

USDI-BLM (1994b) also developed general information on potential salinity problems within the analysis area. This information suggests that 85 percent of the analysis area has less than a 25 percent chance of a salinity problem while the balance, 15 percent of the analysis area, has greater than 50 percent chance of a salinity problem. The greater percent chance of a salinity problem occurs on the alluvial bottomlands of perennial streams in the analysis area such as Hams Fork, Blacks Fork, and Smiths Fork. These perennial streams saturate associated soils where significant evapotranspiration occurs and a build up of salts at the soil surface results. Increases in salinity have likely occurred due to increased erosion of soil derived from marine sediments, leaching of salts from the soil, and deposition in streams.

As indicated in Table 3-7, only Green River, Slate Creek, Hams Fork, Big Muddy Creek, and Smiths Fork are WDEQ Class 2. Blacks Fork is a Class 3 stream, while all other streams are either Class 3 or Class 4. The Glossary defines the WDEQ classifications. These classifications do not correlate with the WGFD classes identified in Section 3.6.1.1.

3.6.1.3 Surface Water Use

Surface water in the analysis area is appropriated and used for numerous beneficial purposes such as agriculture, industry, recreation, and domestic water supply (USDI-BLM 1979, 1991a). Salinity has been noted as the "single greatest factor limiting water use in the area" and is a concern relative to downstream water uses in the Colorado River System (USDI-BLM 1991a).

According to the Wyoming Water Planning Program (1970), development of extensive energy resources within the Green River Basin could significantly increase water consumption from the Green River. Approximately 6,200 acres of irrigated agricultural lands occur within the Moxa analysis area. Assuming that the average application of flood irrigation water is four ac-ft per acre, approximately 24,800 ac-ft is likely diverted from the perennial streams each year for these purposes. Based on a database inquiry submitted to the Wyoming

Table 3-8. Characteristics of Surface Water Quality in the Moxa Analysis Area.

Water Quality Parameter	KRA DEIS Avg. for Blacks Fork USGS Station #09224700	Blacks Fork	Dry Muddy Creek	Chicken Draw	Sevenmile Wash	Little Dry Creek	Shute Creek	Slate Creek #1	Slate Creek #2
Bicarbonate (mg/l)	261	178	128	339	173	180	141	—	206
Carbonate (mg/l)	3.3	40	0	0	7	0	0	—	0
Calcium (mg/l)	88	208	65	480	47	29	105	97	83
Magnesium (mg/l)	40	0	11	193	37	27	71	31	44
Sodium (mg/l)	183	372	72	136	94	98	599	84	137
Potassium (mg/l)	4	6	5	193	23	27	10	27	—
Chloride (mg/l)	61	78	1	0.5	0.5	0.5	234	—	31
Sulfate (mg/l)	444	891	201	94	73	60	1184	—	360
TDS (mg/l)	640	2660	575	332	1293	1800	3208	4	968
pH	—	—	7.7	7.7	7.8	8.3	7.9	7.5	7.8
Conductivity (lab)	—	—	625	550	525	590	2805	—	1252
Nitrate (mg/l)	—	—	2	9	1.5	6.8	1.4	—	0.95
Phosphate (mg/l)	—	—	40	95	36	90	85	—	28
SS (mg/l)	—	—	209	23,000	1393	160	655	0.7	250
Hardness (mg/l)	—	—	268	783	124	113	546	523	560
Alkalinity (mg/l)	—	—	108	278	108	147	97	142	206
Conductivity (mg/l)	—	—	620	385	320	500	4200	927	1280
Fluoride (mg/l)	—	—	0.4	0.3	0.3	0.1	0.4	—	0.3

State Engineer's Office (SEO), there are approximately 125 surface water rights in the Moxa analysis area.

3.6.1.4 Waters of the U.S.

Most of the surface water features in the analysis area (Exhibit 3-5) qualify as waters of United States; however, the Army Corps of Engineers (COE) does not consider vegetated swales to be waters of the U.S. Any activity that involves discharge of dredge or fill material into or excavation of such areas is subject to regulation by the COE. Activities that modify the morphology of stream channels are also subject to regulation by the SEO of Wyoming. Special aquatic sites and wetlands are discussed in greater detail in the Vegetation Section 3.8.

3.6.2 Groundwater

3.6.2.1 Location and Quantity

The analysis area occurs in the Green River groundwater region (USDI-BLM 1985a). Groundwater is present below certain depths everywhere in the analysis area but is only readily obtainable in economically usable quantities where saturated rocks are porous and permeable enough to store and transmit the water at adequate rates (Lowham et al. 1985).

Groundwater in the Green River Structural Basin occurs in 1) unconsolidated floodplain and terrace deposits of origin; 2) conglomerates and sandstones of the Bridger Formation; 3) Laney Shale member of the Green River Formation; 4) sandstones, limestones, mudstones, and shales of the Wasatch and Fort Union formations; and 5) sandstones, quartzites, dolomites, limestones, and shales of Mesozoic and Paleozoic age (USDI-BLM 1979). Table 3-9 summarizes the characteristics of the hydrostratigraphy in the analysis area. Groundwater occurs in both water table (unconfined) and artesian (confined) conditions (Welder 1968; USDI-BLM 1979). Most groundwater in the analysis area is obtained from shallow alluvial aquifers and from the Tertiary Wasatch Formation. Other important water-bearing formations in the analysis area include the Meas Verde Group, Fort Union Formation, Green River Formation, and the Bridger Formation (Lowham et al. 1985; Teller and Chafin 1986). Aquifer recharge occurs to the west from the Overthrust Belt. In addition, the Hams Fork and Green River recharge the aquifer to a limited extent (USDI-BLM 1991a).

Water yields from unconsolidated floodplain and terrace deposits range from less than ten gallons per minute (gpm) in glacial deposits to a possible maximum of 500 gpm in clean sands and gravels (USDI-BLM 1979). The USGS (1991) report that some wells completed in glacial drift could have yields up to 1,350 gpm. Aquifers with the greatest potential for yields in excess of 500 gpm from wells between 2,000 to 5,000 feet deep in Wasatch or Fort Union formations (USDI-BLM 1991a). Most of the proposed gas wells associated with the Moxa project would be completed to a target depth of 12,800 feet within the Frontier and Dakota formations. Thus, wells would intersect groundwater-bearing formations.

3.6.2.2 Quality

Table 3-9 indicates the general quality of water for the various formations. Water in aquifers is primarily of the sodium bicarbonate type although some sodium sulfate and sodium chloride type water occur (USDI-BLM 1979, 1991a). High dissolved solids concentrations are frequently a source of poor groundwater quality. Although yields are high in the Green River and Wasatch Formations below 300 feet, water quality is variable and total dissolved solid (TDS) concentrations are usually greater than 1,000 mg/l (Lowham et al. 1985). Generally, groundwater in the Green River Basin becomes more saline with increased depth as saline minerals are leached from rocks of the aquifer (USDI-BLM 1979) and with increased distance from recharge areas.

Well drilling and completion within the Moxa area to date could have caused adverse effects on groundwater quality due to the mixing of variable quality water from different aquifers. Groundwater at depths usually occurs under pressure due to confining beds. Once pierced, groundwater can migrate vertically up and down the well bore and mix with groundwater at different depths. Depending on the quality of waters that mix, this could result in a reduction in groundwater quality. Improper well completion, inadequate depths of casing, and corrosion of casing are potential sources of groundwater mixing. Studies are under way in the Granger area to determine if mixing and contamination have occurred. No conclusions have been reached at this time in regard to the occurrence of mixing and potential groundwater contamination.

Table 3-9. Characteristics of Hydrostratigraphy Underlying the Moxa Analysis Area.

Geologic Unit				Description
Period	Epoch	Formation	Depth (ft)	
Tertiary	Eocene	Alluvium		Clay, silt, sand, and gravel primarily associated with surface drainages. The coarser sand and gravel deposits can provide significant quantities of potable groundwater.
		Bridger		Mudstone with interbedded sandstone and limestone exposed at the surface throughout the analysis area. Approximately 1,800 ft thick (Koenig 1960). Locally, the sandstones can provide potable water, but non-potable water also occurs (Welder 1968).
		Green River	1,700	Heterogeneous mixture of limestone, mudstone, siltstone, and sandstone. Consists of the Laney Shale, Wilkins Peak Mbrs. All members contain sandstone layers capable of supplying significant quantities of non-potable water. The presence of trona and evaporate deposits in the Wilkins Peak Mbr contribute to its extremely poor water quality (Welder 1968).
	Paleocene	Wasatch	3,900	Variegated claystone with lenticular beds of sandstone. Upper portions of the Wasatch Fmn intertongue with the 1,700-foot thin Tipton Shale in the Moxa Arch region (Hallock 1960). Water quality largely unknown, but probably has high TDS concentrations (Welder 1968).
		Fort Union	6,500	Sandstone, shale, and siltstone with interbedded coal in lower part. Approximately 2,400 ft thick in the Moxa Arch region (Hallock 1960). Water quality largely unknown, but probably has high TDS concentrations (Welder 1968).
Cretaceous	Upper	MesaVerde	7,400	Sandstone and siltstone with interbedded shale in upper part. Sandstone (Ericson equivalent) with conglomerate in lower part. Approximately 500 ft thick in the Moxa Arch region (Hallock 1960). The Ericson sandstone equivalent may be capable of producing groundwater; however, the water quality is unknown.
		Hilliard Shale	11,300	Marine shale with occasional interbedded sandstone. Approximately 3,700 ft thick in the Moxa Arch region (WGA 1979). This thick shale is an aquitard that hydraulically separates the overlying lithology from the target zones in the Frontier Fmn and the Dakota Sandstone.
	Lower	Frontier	11,300	Interbedded shale, mudstone, siltstone, and sandstone. Approximately 450 ft thick in the Moxa Arch region (Winn and Smithwick 1980). Prolific gas producer in the lower sandstones (e.g., 2nd Frontier sandstone). At the analysis area, the Frontier Fmn is encountered between 10,000 to 12,000 ft below ground surface.
		Aspen Shale	12,300	Marine shale, bentonite, and porcelainite. Approximately 400 ft thick in Moxa Arch region (Hallock 1960).
		Dakota Sandstone		Sandstone with gas-producing potential.

3.6.2.3 Development/Use of Groundwater Resources

Development of groundwater has been negligible on a region-wide basis but has locally affected some aquifers. For example, water levels have declined and more-or-less "stabilized" for the MesaVerde Group as measured near Rock Springs over the time period from 1946 to 1986. Range in water level change was from nearly +2 feet to approximately -3.2 feet (Freethey 1987). Availability, quality, and cost are three limiting factors to groundwater use in Wyoming. For the State, water use was 34 percent industrial, 15 percent domestic, five percent livestock, and 46 percent irrigation (Larson 1984).

Based on a recent database base request to the Wyoming SEO, there appears to be at least 126 water wells drilled in the Moxa analysis area. Most of these wells are associated with oil and gas development and other mining for use in drilling, treatment, and or domestic uses. Other wells have been drilled for irrigation, domestic, and industrial purposes. Most of these wells were completed at depths less than 1,000 feet.

3.7 FISHERIES

Most of the drainage basins within the Moxa analysis area are ephemeral or intermittent and are dry much of the year. The three primary intermittent/ephemeral drainages that flow through the analysis area are Slate Creek, Shute Creek, and Sevenmile Wash. None of these support sustainable fish populations due to insufficient flow. Slate Creek and Shute Creek drainages flow in a general eastward direction into the Green River. Sevenmile Wash flows south into the Blacks Fork. The Hams Fork and Blacks Fork rivers converge near Granger in the east-central portion of the analysis area. Although these sections of river support both game and nongame fish species, the fishery is limited in both quality and quantity. The analysis area is bounded on the northeast by the Green River, which together with the Blacks Fork River, flows in a general southeastward direction into the Flaming Gorge Reservoir.

Game fish in the Hams Fork include brown trout (*Oncorhynchus*) and white fish (*Prosopium wulliamsoni*) and, in the Blacks Fork, the channel catfish (*Ictalurus punctatus*). The Green River/Fontenelle Reservoir game fish include rainbow (*Salmo gairdneri*) and cutthroat (*Salmo clarki*) trout, while the largemouth bass (*Micropterus salmoides salmoides*) occurs in the downstream reaches of the Green River and Flaming Gorge Reservoir. The nongame species in the Green River and Blacks Fork include carp (*Cyprinus carpio*), white sucker (*Catostomus commersoni*), mountain sucker (*Castostomus platyrhynchus*), fathead minnow (*Pimephales promelas*), Utah chub (*Gila atraria*), speckled dace (*Rhinichthys osculus*), Bonneville redside shiner (*Richardsonius balteatus hydrophlox*), red shiner (*Notropis lutrensis*), mottled sculpin (*Cottus bairdi*), and sensitive fish species (described in Section 3.10) including flannelmouth sucker (*Catostomus latipinnis*), bluehead sucker (*Catostomus discobolus*), and roundtail chub (*Gila robusta*).

3.8 VEGETATION AND WETLANDS

3.8.1 General Vegetation

The project analysis area occurs in the Northern and Central Intermountain Desertic Basins plant growth region (Thornburg 1982). Precipitation, available moisture, and soil parent material are controlling factors for plant community composition and distribution. Vegetation primarily consists of low and intermediate mixed desert shrubs, with grasses and forbs in the understory and intershrub areas (Stechman 1986). Trees are generally absent in the analysis area, although some cottonwoods are present along portions of perennial stream channels and juniper are scattered in a few sites over a very small area within the southern extent of the analysis area. Shrubs that grow along riparian areas may be tree-like. Shale outcrops and mixed pediment windswept ridges support sparse vegetation cover of low-growing cushion plants. Stabilized sand dunes occur throughout the analysis area. Wetlands and numerous revegetated areas are also dispersed throughout the analysis area. Agricultural lands, including hay meadows, occur in some bottomland areas (USDI-BLM 1991a), particularly those associated with the perennial river bottomlands.

There are concerns about the establishment and dominance of weeds in the analysis area because weed species often out-compete the more desirable native species and provide a high degree of visual contrast with the surrounding native vegetation. Further, weeds often reduce the productivity of a site and reduce the value of the forage to wildlife and livestock. Weeds occur at varying densities and frequencies within the analysis area. The frequency and cover of weeds increase in disturbed areas such as along or near roads, highways, drill sites, pipeline ROWs, livestock watering areas, etc. Table 3-10 identifies the weed species for the analysis area. During onsite investigations, weed infestations (up to 20 acres) of halogeton (*Halogeton glomeratus*), perennial pepperweed (*Lepidium latifolium*), Russian thistle (*Salsola iberica*), and pubescent whitetop (*Cardaria draba, C. pubescens*) were observed. Quackgrass (*Agropyron repens*) is common in wet meadow bottomlands associated with the perennial streams, as is houndstongue (*Cynoglossum officinale*) and common burdock (*Arctium minus*).

Some native plant species are poisonous to livestock. Milkvetch (*Astragalus* spp.) and locoweed (*Oxytropis* spp.) are the most common of such poisonous plants (USDI-BLM 1979). Others include larkspur (*Delphinium* spp.), horsebrush (*Tetradymia* spp.), halogeton, greasewood, deathcamas (*Zigadenus* spp.), arrowgrass (*Triglochin maritima*), tansy mustard (*Descurainia pinnata*), and cocklebur (*Xanthium* spp.). In general, these species are common throughout the analysis area but are minor components of vegetal cover.

Fourteen general vegetation cover types occur in the analysis area: mountain shrub, juniper woodland, mixed desert shrub, vegetated sand dunes, alkali scrub, barren lands, urban land, agricultural land, revegetated areas, riparian forest/shrub, wet meadow, marsh, aquatic bed, and riverine (i.e., stream channels). Detailed descriptions of each are presented in the Vegetation, Wetlands, and Special Status Plant Species Technical Report (ECOTONE 1995b) on file with the BLM Rock Springs District Office. Exhibit 3-6 depicts the more common cover types, and Table 3-11 summarizes the area for the mapped cover types.

Practically none of the mountain shrub or juniper woodland cover types have been affected by past disturbances. Roughly 18,414 acres (six percent) of the mixed desert shrub cover type, 3,097 acres (five percent) of the vegetated sand dunes cover type, 3,076 acres (seven percent) of the alkali scrub cover type, 718 acres (two percent) of the barren lands cover type, and 525 acres (nine percent) of the agricultural lands have been affected due to past disturbances. As indicated in (Table 2-6 of Chapter 2), the analysis area has been subjected to numerous development projects resulting in revegetated disturbances. Reclamation success varies from very poor to excellent, as is summarized in the Soils Section 3.5 of this EIS and detailed in the Soils and Water Resources Technical Report (ECOTONE 1995a).

Cushion plant communities are areas of special concern both from a biological standpoint and from a soils and reclamation standpoint, and the occurrence of this community is limited. The BLM has identified a community site ten miles west of the Moxa analysis area boundary as "the best example . . . found in Wyoming" and has applied a "no surface occupancy" stipulation (USDI-BLM 1986). This site, known as the Kemmerer cushion plant community, contains an endemic plant (known only in Wyoming), near endemic plants (known only from two states), and regional endemics (known only from three to five states). Although the BLM has only designated the area outside of Moxa, cushion plants were located on wind-swept ridges within mixed desert shrub and barren lands cover types within the analysis area.

3.8.2 Waters of the U.S., Including Wetlands

Of the fourteen general vegetation cover types, five likely qualify as special aquatic sites (including jurisdictional wetlands) and would be subject to regulation by the COE under Section 404 of the CWA. These are alkali scrub (portions of the lowland areas within this cover type), riparian forest/shrub (portions), wet meadow, marsh, and aquatic bed. Perennial stream channels are waters of the U.S. and in many cases are special aquatic sites. Intermittent and ephemeral drainage channels (i.e., the Riverine cover type) that show signs of consistent channel forming processes (i.e., are at bed and grade) and are free of vegetation also qualify as waters of the U.S. Such areas have the same protection as special aquatic sites.

Wetland areas were initially identified on National Wetland Inventory (NWI) maps produced by the U.S. Fish and Wildlife Service (FWS). Ground-truthing and sampling of wetland areas using the routine on-site approach (Environmental Laboratory 1987) occurred during the summer and fall of 1994 (ECOTONE 1995b). Data were gathered at 33 sample points. In addition to these sample points, supplementary data was obtained from the Kern River Lateral project (ECOTONE 1992b). Reconnaissance-level wetland investigations were performed in support of, but do not replace, site-specific jurisdictional wetland inventories necessary for CWA 404(b)(1) guidelines compliance.

Table 3-10. **Noxious and Undesirable Weeds for the Moxa Analysis Area.**[1]

Scientific Name	Common Name	Scientific Name	Common Name
Agropyron repens	Quackgrass	*Cynoglossum officinale*	Houndstongue
Arctium minus	Common burdock	*Euphorbia esula*	Leafy spurge
Avena fatua	Wild oat	*Fraseria discolor*	Skeletonleaf bursage
Cardaria draba, C. pubescens	Hoary cress, whitetop	*Hordeum jubatum*	Foxtail barley
Carduus acanthoides	Plumeless thistle	*Hyoscyamus niger*	Black henbane
Carduus nutans	Musk thistle	*Isatis tinctoria*	Dyers woad
Centaurea diffusa	Diffuse knapweed	*Lepidium latifolium*	Perennial pepperweed
Centaurea maculosa	Spotted knapweed	*Linaria dalmatica*	Dalmatian toadflax
Centaurea repens	Russian knapweed	*Linaria vulgaris*	Yellow toadflax
Chrysanthemum leucanthemum	Ox-eye daisy	*Onopordum acanthium*	Scotch thistle
Cirsium arvense	Canada thistle	*Sonchus arvensis*	Perennial sowthistle
Convolvulus arvensis	Field bindweed		

1 - Sources: Lincoln County Weed & Pest District 1994; Sweetwater County Weed & Pest District 1994; and Uinta County Weed & Pest District 1994.

Table 3-11. **Common Vegetation Cover Types, Area, and Percent Total Area.**[1]

Vegetation Cover Type	Total Area (Acres)	Percent Total Area
Mixed Desert Shrub	309,882	66
Vegetated Sand Dunes	57,902	12
Alkali Scrub	42,249	9
Barren Lands	29,362	6
Urban	14,828	3
Agricultural Lands	5,599	1
Revegetated Areas	11,171	2
Waters of the U.S.[2]	5,268	1
TOTAL AREA	**476,261**	**100**

1 - Cover types and acreages based on the vegetation map and Chapter 2. Other vegetation cover types with <1 percent coverage are included within these cover type acreages.

2 - See Table 3-12 for a detailed breakdown of waters of the U.S., including wetlands, by cover type.

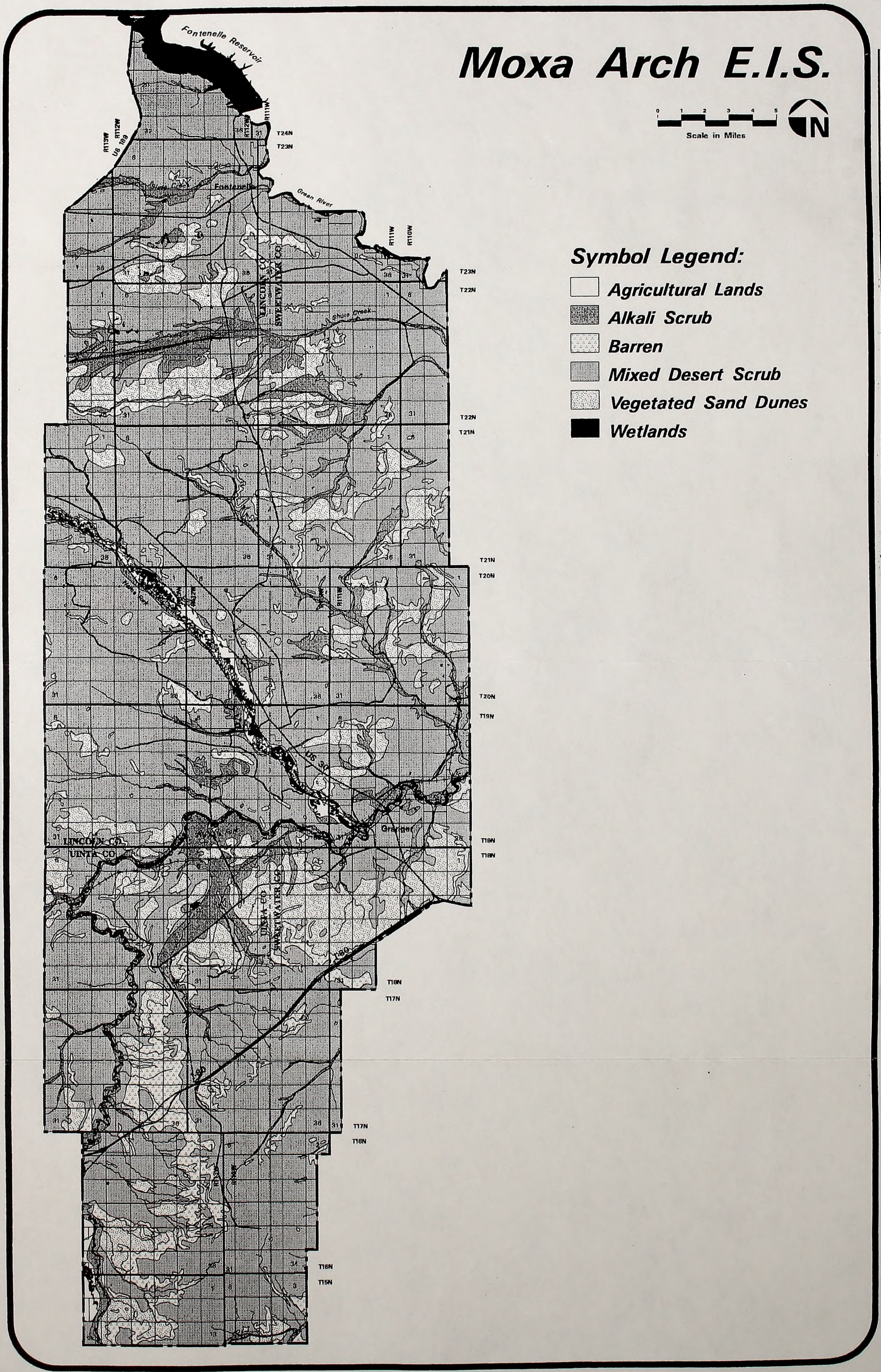

Exhibit 3-6. Vegetation Cover Types within the Moxa Analysis Area.

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As Exhibit 3-5 indicates, most of the wetlands are associated with perennial drainages. Table 3-12 summarizes the acreages by cover type for waters of the U.S. and classifies each type according to size and the permanence of water. The detailed descriptions of wetland cover types provided in the Vegetation, Wetlands, and Special Status Plant Species Technical Report (ECOTONE 1995b) represent arbitrarily defined groups along a continuum. Approximately 169 acres (three percent) of wetlands have been disturbed by past activities within the analysis area.

Wetlands have gained considerable recognition for their value in maintaining biological, physical, and socioeconomic systems. Professional judgement was used to determine the functional values of wetlands within the analysis area following Adamus (1983), Adamus and Stockwell (1983), and Adamus et al. (1987). Values were assigned for each wetland or special aquatic site cover type (Table 3-13). Values inherently incorporate differences created by the dissimilarity in cover type vegetation height, condition, and hydroperiod. ECOTONE (1995b) discusses each functional value relative to wetlands in the analysis area.

3.9 WILDLIFE

Wildlife habitats that would be affected by the project include both the areas which would be physically disturbed by the construction of production wells, related roads, pipelines, and production facilities as well as the zones of influence surrounding them.

A wide variety of wildlife habitats and their associated species occur on the proposed analysis area. This diversity is due primarily to the variety of aspects, elevations, and substrates which are products of the broken topography and the interspersion of vegetation types in the area.

3.9.1 Wildlife Habitat

The analysis area supports a diversity of wildlife habitats and their associated species. Six primary wildlife habitat types are associated with the construction of the production wells and related facilities. These habitat types correspond with vegetative cover types described in the Vegetation section (Section 3.8) and include five upland and one general wetland type. Upland habitats include 1) mixed desert shrub, 2) vegetated sand dunes, 3) alkali scrub, 4) barren lands, and 5) agricultural lands.

Efforts are currently being made to identify specific opportunities to reduce the impact of oil and gas development on pronghorn and livestock in this area through the development of a Pronghorn and Livestock Mitigation Plan. This plan is being developed by the University of Wyoming FWS Cooperative Research Unit under contract with the BLM and the oversight committee (comprised of energy company contributors, private landowners, WGFD, and BLM).

3.9.2 General Wildlife

Approximately 246 wildlife species have been recorded on or within the same townships as the analysis area, either as residents or as migrants. These include 37 species of mammals, 206 species of birds, and three species of reptiles and amphibians. A list of the species observed in the analysis area and surrounding region is presented in the Wildlife Technical Report (HWA 1994). The presence and distribution of these wildlife species were determined from published literature, unpublished data from federal and State agencies, databases from private organizations, and on-site surveys conducted during 1994 (HWA 1994). It should be noted that this list is by no means complete since there have been no specific surveys conducted for small mammals and herptiles, and information on these species is lacking. Although all the species presented in the technical report are important members of wildland ecosystems and communities, most are common and have wide distributions in the region. Consequently, the relationship of these species to the proposed project is not discussed in the same depth as species which are threatened, endangered, rare; of special economic interest; or otherwise of high interest or unique value.

3.9.3 Big Game

Four big game species, pronghorn antelope (*Antilocapra americana*), mule deer (*Odocoileus hemionus*), elk (*Cervus elaphus*), and moose (*Alces alces*) occur on the analysis area. These animals are managed by the WGFD in major herd units.

Pronghorn Antelope. The analysis area encompasses portions of three major antelope herd units: West Green River, Carter Lease, and Uinta-Cedar Mountain (Exhibit 3-7). Approximately 25, ten, and five percent of the

Table 3-12. Waters of the U.S. Cover Types (including Wetlands), Area, and Percent Total Area.[1]

Waters of the U.S. Cover Types	Cowardin Classification[2]	Area (Acres)	Percent Total Wetland Area
Lowland Alkali Scrub[3]	• Palustrine Scrub-Shrub Broad-leaved Deciduous Temporarily/Seasonally Flooded	--	--
Riparian Forest/Shrub	• Palustrine Scrub-Shrub Broad-leaved Deciduous Temporarily/Seasonally Flooded • Palustrine Forested Broad-leaved Deciduous Temporarily/Intermittently Flooded	387	7
Wet Meadow	• Palustrine Emergent Persistent Seasonally/Temporarily Flooded • Palustrine Unconsolidated Shore Temporarily/Seasonally/ Semipermanently Flooded	2,387	46
Marsh	• Palustrine Emergent Persistent Semipermanently Flooded	225	4
Aquatic Bed	• Palustrine Aquatic Bed Semipermanently/Temporarily Flooded • Palustrine Unconsolidated Shore Seasonally/Temporarily/Semipermanently Flooded • Palustrine Unconsolidated Bottom Temporarily/Semipermanently Flooded	310	6
Riverine	• Riverine Intermittent Streambed Temporarily Flooded	1,959	37
TOTAL		**5,268**	**100**

1 - Acres based on National Wetland Inventory Map delineations.

2 - Cowardin et al. 1979.

3 - Lowland Alkali Scrub cover type area is contained within the Riparian Forest/Shrub type on the NWI map delineations.

respective herd units are contained within the analysis area. Major differences exist between the herd units with regard to habitat, antelope population characteristics, and harvest strategies. The boundaries for these units generally correspond with major roads, which are usually fenced and prevent antelope from migrating across unit boundaries. The fenced highway along I-80, for example, divides the Uinta-Cedar Mountain hunt unit from others, and relatively little interchange occurs between them (WGFD 1992a). Data on major antelope herd units are shown in Table 3-14.

Table 3-13. Estimated Functional Values for Special Aquatic Sites (including Wetlands) and Other Waters of the U.S. within the Moxa Analysis Area.

Waters of the U.S. Cover Types	Function[1]								
	GWR	GWD	FSD	SAD	SED	NRR	FCS	HAB	REC
Wetlands:									
Lowland Alkali Scrub	x	o	o	o	x	x	x	x	x
Riparian Forest/Shrub	x	x	+	+	+	x	x	+	x
Marsh	+	+	x	x	x	+	+	+	x
Wet Meadow	x	x	x	x	x	x	x	x	x
Other:									
Aquatic Bed	+	x	x	o	x	+	+	+	x
Riverine	+	x	o	o	x	x	x	x	x

Values:

+ - major functional value
x - minor functional value
o - minimal or no functional value

1 - Wetland and Special Aquatic Site Functions (Adamus and Stockwell 1983):

FSD - flood storage and desynchronization
SAD - shoreline anchoring and dissipation of erosive forces

Functions, Continued:

SED - sediment trapping
NRR - nutrient retention and removal
FCS - food chain support
GWR - groundwater recharge
GWD - groundwater discharge
HAB - wildlife and fish habitat
REC - active and passive recreation and heritage value

Pronghorn antelope use the analysis area year-round. Post season population estimates for the three herd units range from 18 to 36 percent below objective. Baseline data did not afford a population estimate for the analysis area; however, 1993 data from the WGFD indicate a mean density of three antelope per square mile (Table 3-14). Antelope production in the analysis area ranges from 26 to 55 fawns per 100 does and has declined by as much as 61 percent from the four-year pre-season average fawn crop from 1989-1992. This has been attributed to the severe winter conditions of 1992-93, combined with sustained drought throughout the region, resulting in inhibited reproductive success of adult females (WGFD 1993a).

Approximately 231 square miles or 34 percent of pronghorn habitat on the analysis area is classified as crucial winter range which extends in a wide band from Little America westward and branches off into numerous fingers near the western edge of the analysis area (Exhibit 3-7). Additional crucial winter range is situated along much of the uppermost northern portion of the analysis area. Severe Winter Relief Habitat comprises another 29 square miles and is situated in an area between Granger and I-80, and along the southwest portion of the analysis area. Winter/yearlong and summer or spring/summer/fall ranges are limited primarily to the northern three-fourths of the permit area, while yearlong range occurs in the southern quarter. Movements across the analysis area are likely when antelope shift between seasonal ranges.

Mule Deer. The analysis area is contained almost entirely within the Uinta and Wyoming Range mule deer herd units, while only a small portion of the northeastern edge of the analysis area lies within the

Table 3-14. Population Parameters for Big Game Herd Units within the Moxa Analysis Area.

Species	Herd Unit	Herd Unit Number	Hunt Areas	Size (Sq. miles)	Population Estimate	Population Objective	Density Estimate[1]	Percent Contained within Moxa	Fawn:Doe Ratio
Antelope	West Green River	417	93	1,590	6,400	8,000	4.02	24.7	55:100[2]
	Carter Lease	419	94, 98, 100	2,649	3,850	6,000	1.45	10.0	26:100[2]
	Uinta-Cedar Mtn.	411	95, 99	2,264	8,153	10,000	3.60	5.10	29:100[2]
Mule Deer	Steamboat	430	131	4,071	2,048	4,000	0.50	0.20	43:100[3]
	Wyoming Range	131	34, 135-137, 143-145, 15	5,588	25,803	50,000	4.62	11.6	49:100[3]
	Uinta	423	132, 133, 168	2,649	12,500	7,000	4.72	4.40	42:100[3]
Elk	West Green River	428	102-105	4,264	3,100	3,100	0.73	15.4	48:100[3]
	Uinta	423	106, 107	2,221	7,107	600	3.20	5.20	43:100[3]
Moose	Lincoln	417	26, 33, 40	3,580	1,133	1,500	0.32	18.3	35:100[3]
	Uinta	415	27, 35	2,162	935	600	0.43	5.40	51:100[3]

1 - Number of animals per square mile of occupied habitat

2 - Prehunt Classification

3 - Posthunt Classification

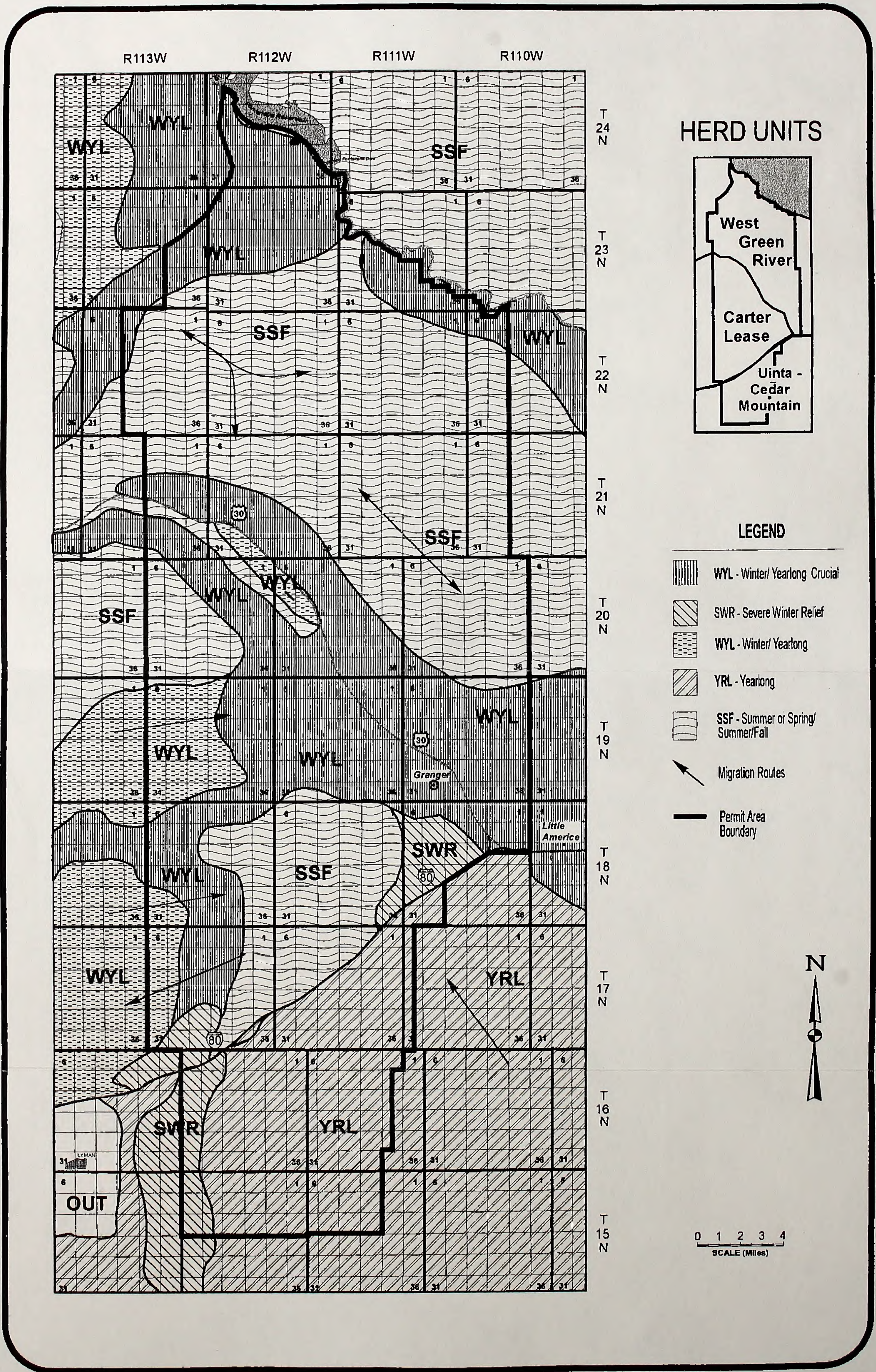

Exhibit 3-7. Seasonal Pronghorn Ranges within the Moxa Analysis Area.

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Steamboat herd unit (Exhibit 3-8). Approximately 4, 12, and 0.2 percent of the respective herd units are contained within the analysis area. Major differences exist between the adjacent herd units with respect to habitat, mule deer population characteristics, and management strategies. Data on major mule deer herd units and population parameters for each herd unit are shown in Table 3-14.

Post-season population estimates range from 48 to 49 percent below the objectives for the Wyoming Range and Steamboat herd units, respectively, to 79 percent above objective for the Uinta herd unit. No baseline population estimates are available for mule deer in the analysis area; however, 1993 data from the WGFD indicate a mean density of 3.3 mule deer per square mile (Table 3-14). Mule deer production in the analysis area ranges from 42 to 49 fawns per 100 does and has, between 1989 and 1992, declined by as much as 38 percent for the four-year average. As with pronghorn, this decrease has been attributed to the long-term drought conditions in the region which has reduced the ability of adult females to produce healthy fawns (WGFD 1993a).

Although mule deer occupy portions of the analysis area year-round, most of the analysis area (87 percent) is not classified as mule deer range and their distribution is limited to mostly river bottom habitats in the general region. No crucial mule deer winter range occurs on the analysis area, but does occur approximately three miles to the northwest of the permit area (see Exhibit 3-8). Winter/yearlong range is situated in the extreme northeast and southwest corners of the analysis area and in a small band near the east-central portion of the permit boundary, while yearlong range occurs in a narrow band that closely parallels the Hams Fork River along U.S. 30.

White-tailed Deer. Small populations of white-tailed deer occur along the river bottom habitats of the Hams Fork River and possibly the Blacks Fork. These animals are yearlong residents and seldom venture far from riparian habitats along the stream courses.

Elk. The analysis area contains portions of the Uinta and West Green River herd units. Approximately five and 15 percent of the respective herd units are contained within the analysis area, although only the West Green River unit contains seasonal range. Elk use of habitats within this area is seasonal and is limited almost exclusively to the extreme northern portion of the analysis area (Exhibit 3-9). This area, classified as Severe Winter Relief, occupies only 59 square miles or 0.001 percent of the analysis area. Data on major elk herd units and population parameters are shown in Table 3-14.

The 1993 post-season population estimate for the West Green River herd unit was 3,100 elk, which is equal to the objective of 3,100 animals. The density estimate for elk in this unit is 0.73 animals per square mile of occupied habitat. Elk production in the area averaged 48 calves per 100 cows in 1993, which is near the four year post-season average (1989-1992) of 47.5 calves per 100 cows (WGFD 1993a). This herd unit is the only elk herd in the Bridger Teton National Forest that does not have permanent feed grounds to sustain the wintering populations.

Moose. The analysis area encompasses 5 and 18 percent of the Uinta and Lincoln moose herd units, respectively (Exhibit 3-10). Data on the major moose herd units are shown in Table 3-14.

No designated moose habitat occurs within the Uinta portion of the analysis area. Although the Lincoln herd is one of the largest moose populations in the State, relatively little designated moose habitat occurs within the Lincoln portion of the analysis area and none of it is classified as crucial. Winter/yearlong and yearlong habitats occur in willow riparian areas (WGFD 1992a) along the Lower Hams Fork and Blacks Fork Rivers near the central portion of the analysis area and along the Lower Green River in the northeast corner of the analysis area.

The Lincoln moose herd unit had a 1993 post-season population estimate of 1,133 moose, which is 24 percent below the objective of 1,500 animals. The density estimate for moose in this unit is 0.32 animals per square mile of occupied habitat. In 1993, moose production in the area averaged 35 calves per 100 cows, which is 21 percent lower than the three year post-season average calf crop between 1990-1992.

3.9.4 Upland Game Birds

The mourning dove (*Zenaida macroura*) and sage grouse (*Centrocercus urophasianus*) are the only upland game bird species known to occur in the Moxa analysis area.

Mourning Dove. The mourning dove is common throughout the analysis area, and both migratory and nesting populations are present. These birds are associated with mainly sagebrush-grass, mountain brush, and riparian habitats. Mourning dove populations have decreased slightly since 1988 (WGFD 1993b). According to the WGFD, the slight decrease in mourning dove populations that has occurred since 1988 is probably due to the continued drought conditions throughout the region during this time.

Sage Grouse. The sage grouse is the predominant and most important game bird in the analysis area. The WGFD manages sage grouse by upland game management areas. The analysis area contains portions of the Seedskadee (Area 4), Uinta (Area 5), and Flaming Gorge (Area 6) upland game management areas.

Data from the WGFD indicate that State-wide numbers of sage grouse declined between 1987 and 1992. Despite this decrease, the 1992 annual harvest exceeded 6,000 birds in the three management areas, which contain some of the highest concentrations of sage grouse in the State. Collectively, these three areas accounted for nearly 20 percent of the State-wide annual harvest of sage grouse in 1992 (WGFD 1993b).

The entire analysis area is generally considered year-round habitat for sage grouse. Important areas for these birds are the strutting grounds (leks), brood-rearing areas, and wintering areas. Leks may be located between summer and winter ranges or, in some cases, summer and winter ranges may be the same (Call and Maser 1985). Preferred nesting habitat is usually within a two-mile radius of the strutting grounds (Hayden-Wing et al. 1986).

Based on BLM historical records and an aerial inventory completed in the spring of 1994 a total of 38 sage grouse leks were identified on the analysis area (HWA 1994). Four of these were active, and the activity status for the remaining 34 was unknown because surveys were initiated too late in the breeding season to make an adequate determination as to whether or not these sites were currently being used by grouse. Data from BLM historical records does suggest, however, that nearly all of the leks identified within the analysis area were active within the last five to six years, and many were active when field checked in the past one to three years. The leks have been monitored on alternating years by both BLM and WGFD personnel. Some of the known leks have been impacted by existing facilities. These leks are along some existing roads and near well locations. These leks have been active and in some cases use of the roads has been restricted to mid day hours. The majority of these leks (71 percent) are located in the northern one-third of the analysis area. Lek locations and status are documented in Table 3-15 and illustrated in Exhibit 3-11.

3.9.5 Raptors

Nine species of raptors were observed within the analysis area during aerial and ground surveys conducted in 1994 (HWA 1994). These include the golden eagle (*Aquila chrysaetos*), ferruginous hawk (*Buteo regalis*), red-tailed hawk (*Buteo jamaicensis*), Swainson's hawk (*Buteo swainsoni*), northern harrier (*Cirous cyaneus*), prairie falcon (*Falco mexicanus*), American kestrel (*Falco sparverius*), short-eared owl (*Asio flammeus*), and burrowing owl (*Athene curicularia).* Additional species which have, according to the Wildlife Observation System (WOS), been sighted on or in the vicinity of the analysis area include turkey vulture, bald eagle, rough-legged hawk, merlin, great horned owl, long-eared owl, short-eared owl, and snowy owl. The most commonly sighted raptor was the golden eagle, which was seen throughout the entire analysis area. Most raptor species using the area migrate each fall and return to the region again the following spring. Exceptions include the golden eagle and great horned owl, which are year-round residents, and the rough-legged hawk and snowy owl, which are regular and rare winter residents, respectively.

An aerial inventory of raptor nest locations was conducted in the spring of 1994 (HWA 1994) and covered prime raptor habitats throughout the analysis area. Because the survey was conducted early in the raptor breeding/nesting period (April/May) many raptors had not yet commenced nesting activities and it was not possible to determine the activity status or which species were using many of the nests. Of the 114 nests located within the analysis area, most (93) were inactive at the time of the survey and in many cases (67) could not be identified as to species. Of the nine raptor species identified, active nests of four species were found within the analysis area (Exhibit 3-12). These consist of the ferruginous hawk, prairie falcon, red-tailed hawk, and burrowing owl. Ferruginous hawks, which are known to build multiple nests over time, were sighted frequently

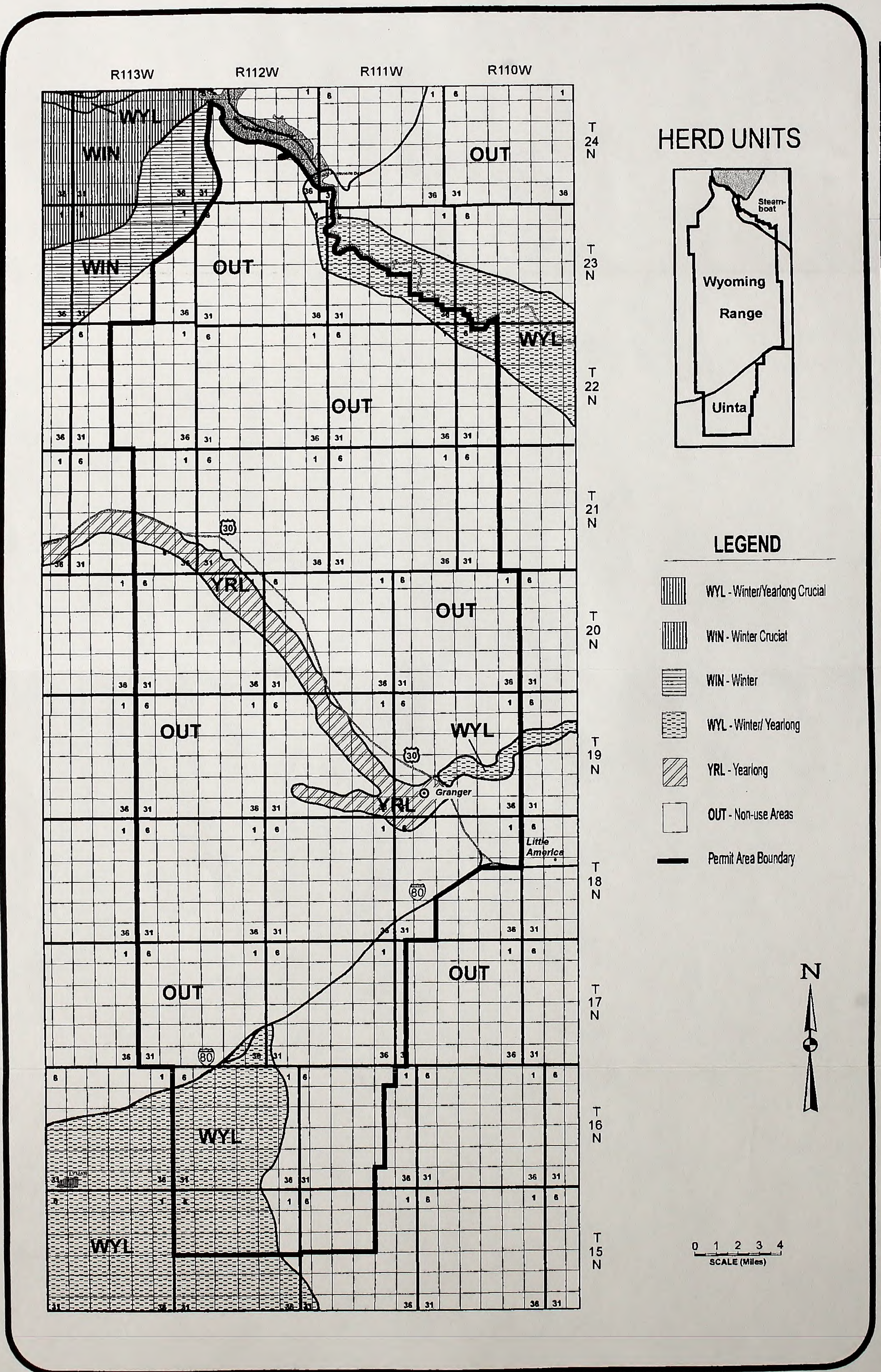

Exhibit 3-8. Mule Deer Habitat Designations.

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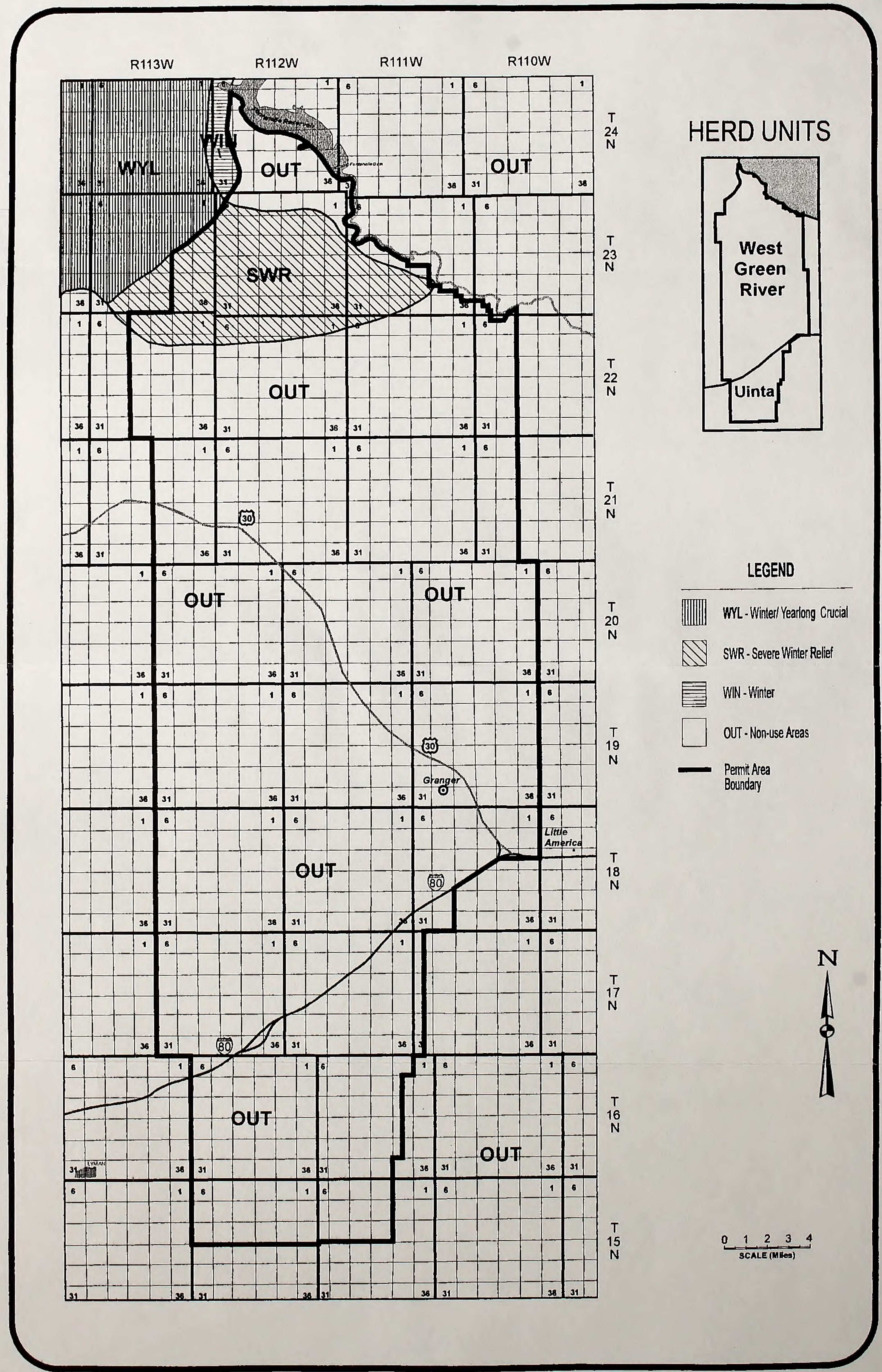

Exhibit 3-9. Elk Seasonal Ranges of the Uinta and West Green River Herd Units.

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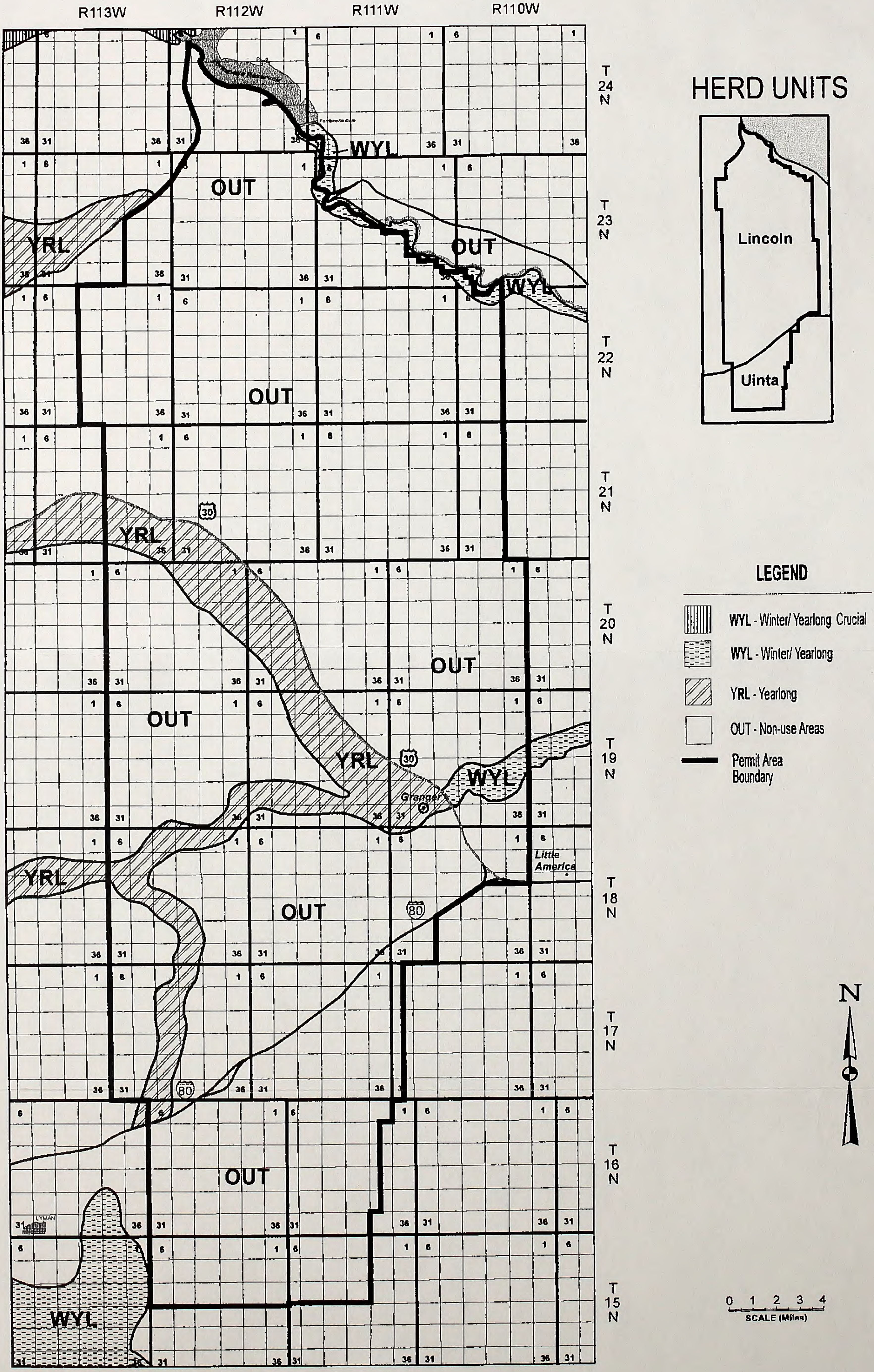

Exhibit 3-10. The Uinta and Lincoln Moose Herd Units.

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Table 3-15. Sage Grouse Lek Locations and Activity Status for the Moxa Analysis Area.

Location				Activity Status	No. of Birds
TwnN	RngW	Sec	1/4 Sec		
22	113	18	SE NE	UNK	N/A
22	110	4	SW SW	UNK	N/A
22	111	2	NW NW	UNK	N/A
22	111	4	NW SE	UNK	N/A
22	111	5	SE SW	UNK	N/A
23	111	32	NW SW	UNK	N/A
23	111	31	SE NE	UNK	N/A
23	111	31	NW NE	ACT	8 m
23	111	30	W SW	ACT	7 m, 2 f
23	112	25	NE	UNK	N/A
23	113	24	NW	UNK	N/A
22	113	8	C	UNK	N/A
22	113	4	C	UNK	N/A
22	113	4	NW NE	ACT	6 m
22	112	8	SE SE	UNK	N/A
22	113	14	SE SE	UNK	N/A
22	112	19	NW SW	UNK	N/A
21	111	3	NW NW	UNK	N/A
23	113	35	NW NW	UNK	N/A
21	113	1	NW NW	UNK	N/A
21	113	19	SW SE	UNK	N/A
22	112	32	SE SE	UNK	N/A
22	112	34	NW	ACT	3 m
22	112	34	SW SW	UNK	N/A
18	112	34	SE SE	UNK	N/A
21	112	22	SE NE	UNK	N/A
21	111	27	SE SE	UNK	N/A
18	113	3	SW	UNK	N/A
18	113	8	SE	UNK	N/A
18	113	29	NE SE	UNK	N/A
18	113	32	NW NW	UNK	N/A
18	113	6	SE NW	UNK	N/A
18	111	19	SE NW	UNK	N/A
18	112	36	NW NW	UNK	N/A
16	112	9	NE SW	UNK	N/A
16	113	34	NE NE	UNK	N/A
15	113	11	SE NE	UNK	N/A
15	113	14	NW NE	UNK	N/A

within the analysis area and many of the 67 unidentified nests that were discovered were probably built by this species.

3.10 SPECIAL STATUS SPECIES

Special status species include those listed as threatened or endangered under the federal Endangered Species Act (ESA) of 1973 as amended, species proposed for federal listing, candidate species, and other species identified by the BLM and Wyoming Natural Diversity Database (WYNDD) (USDI-FWS 1994a,b; WYNDD 1994a,b). The following section presents information required by the ESA in a Biological Assessment (BA).

3.10.1 Special Status Plants

Table 3-16 lists fourteen special status plant species for the Moxa analysis area, their status, habitat, and probability of occurrence. As indicated, only five of these species have been located within the analysis area. The other species occur in nearby areas and could potentially occur in the analysis area.

Habitats for federally listed and C2 species were characterized during 1994; specific fieldwork was performed in a subset of the areas identified as potential habitat for these species (Exhibit 3-13). Incidental fieldwork was accomplished for 3C and WYNDD-sensitive species as part of investigations for listed and C2 species or for other resources (e.g., sensitive soils). The following summarizes pertinent information on each special status plant for the Moxa area. Further details are provided in the Vegetation, Wetlands, and Special Status Plant Species Technical Report (ECOTONE 1995b).

3.10.2 Special Status Animals

The material presented in this section and that presented in Chapter 4 (Section 4.10), along with other appropriate materials in this EIS, are intended to satisfy the requirements for a BA of potential impacts to threatened, endangered, and candidate species listed by the FWS.

The FWS (USDI-FWS 1994a) has determined that four wildlife species, designated as endangered under the ESA of 1973, as amended, have the potential to occur on or in the vicinity of the analysis area. These species are shown in Table 3-17. Nine additional wildlife species that have the potential to occur, or are known to occur in the analysis area, have been designated as either Category C1, C2, or 3C candidate wildlife species by the FWS (USDI-FWS 1994a). These species are shown in Table 3-18.

Black-Footed Ferret. White-tailed prairie dog colonies are essential habitat for the black-footed ferret, which depends on prairie dogs for food and uses the prairie dog burrows for shelter and raising their young (Hillman and Clark 1980; Fagerstone 1987). Since ferrets are nocturnal and spend much of their time underground, their presence in an area is difficult to ascertain but their original distribution in North America closely corresponded to the distribution of white-tailed prairie dogs (Hall and Kelson 1959; Fagerstone 1987).

Habitat for the black-footed ferret exists on the analysis area in the form of extensive white-tailed prairie dog colonies which total 161 in number (Exhibit 3-14). Colony size throughout the entire analysis area averages 285 acres and ranges from 0.72 to 12,931 acres in size. Collectively, colonies comprised an area of 47,664 acres or nearly ten percent of the analysis area. Over 89 percent or 144 of the colonies identified contained areas with burrow densities greater than or equal to eight per acre. These areas of concentration, defined as towns by the FWS, averaged 24 acres in size and ranged from 0.24 to 662 acres collectively within their associated colonies.

Although many of the individual towns by themselves may be too small to support black-footed ferrets, their juxtaposition with other neighboring towns can be important in determining suitable black-footed ferret habitat. For this reason, the FWS has established the concept of a prairie dog complex, which is an aggregation of two or more neighboring prairie dog towns that are separated by a distance of less than 4.34 miles. The outer boundary connecting these towns encloses a total of 304,393 acres, or 63 percent of the analysis area (Exhibit 3-15). Burrow density, on approximately 1.3 percent of this area, equals or exceeds eight burrows per acre. The combined acreage of these prairie dog towns is 3,982 acres, which exceeds the 1,000-acre criteria recommended by the FWS for potential black-footed ferret reintroduction sites. The FWS will be consulted for their recommendations on the need for ferret searches and the status of the area as a potential reintroduction site. A more detailed

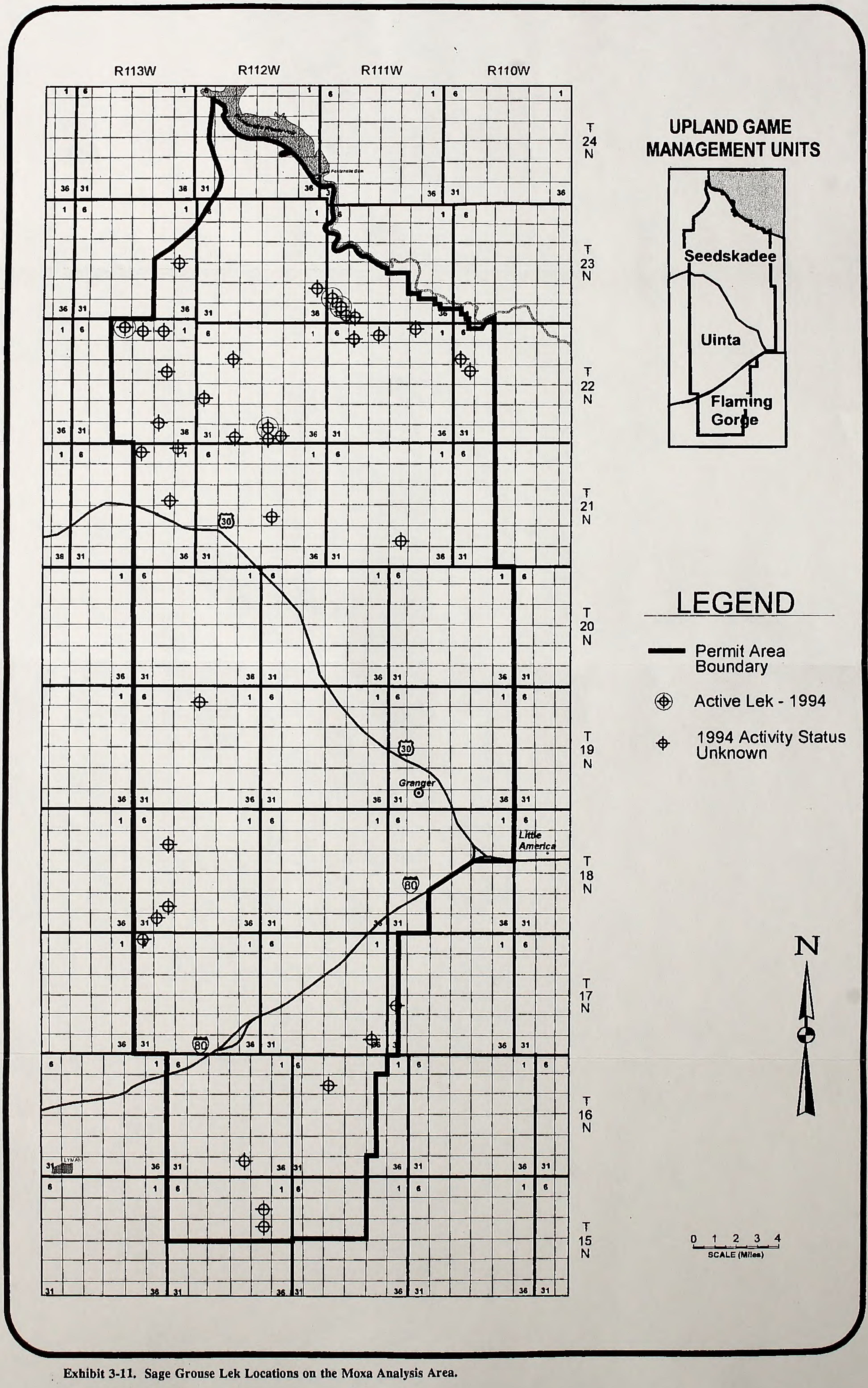

Exhibit 3-11. Sage Grouse Lek Locations on the Moxa Analysis Area.

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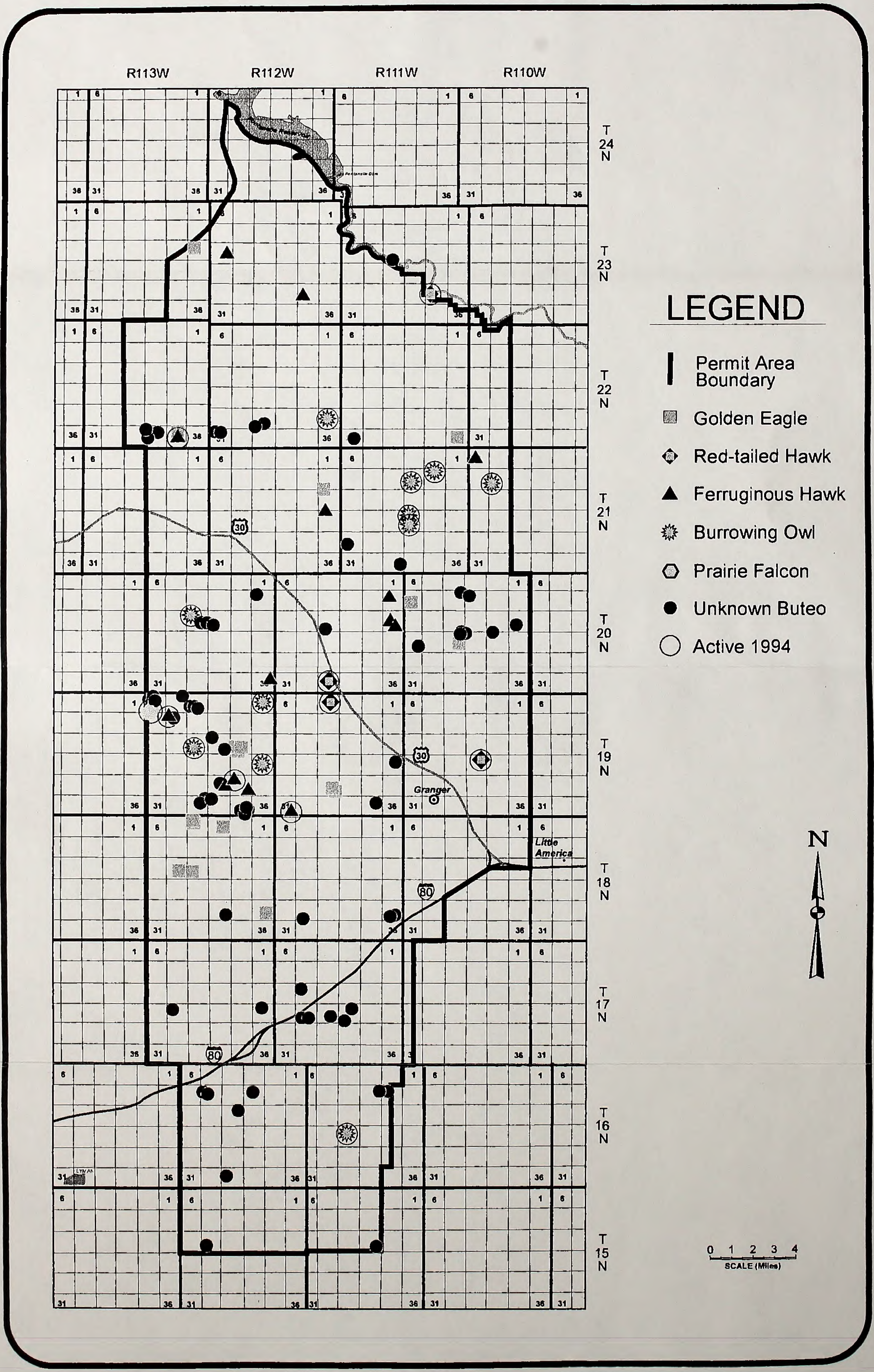

Exhibit 3-12. Raptor Species Nests on the Moxa Analysis Area.

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Table 3-16. Special Status Plant Species--Status and Habitat Characteristics.[1]

Scientific Name	Common Name	Status[2]	Habitat	Probability of Occurrence[3]
Astragalus calycosus	King's milkvetch	G5, S1, LIST 3	sagebrush shrub on rocky hills, barren clay hills; 6,900 ft. Associated vegetation: *Astragalus jejunus*, *Astragalus spatulatus*, *Arenaria hookeri*, *Cryptantha* spp.	possible
Astragalus drabelliformis	Bastard draba milkvetch	C2, G2, S2, LIST 1	open sites on sandstone, stony clay, badlands, and barren clay slopes and ridges; LaBarge and Chappos Mbrs. of Wasatch Fmn.; Green River Basin; 6,900-7,150 ft. Associated vegetation: *Chrysothamnus nauseosus*, *Artemisia* spp. *Macheranthera grindeloides*, *Haplopappus acaulis*, *Leptodactylon pungens*, *Astragalus bisulcatus*, *Arenaria hookeri*	unlikely
Astragalus kentrophyta var. *elatus*	Spinyleaf milkvetch	G5T4, S1, LIST 3	stabilized sand dunes, often slightly disturbed; 6,500 ft. Associated vegetation: *Oryzopsis hymenoides*, *Chrysothamnus viscidiflorus*, *C. nauseosus*, *Agropyron dasystachyum*, *A. smithii*, *Artemisia* spp. *Eriogonum ovalifolium*, *Sarcobatus vermiculatus*	definite
Chamaechaenactis scaposa var. *parva*	Eastwood plant	3C, G4T4, S2, LIST 2	rocky desert flats; desert pavement soil in badlands; 6,200-7,400 ft. Associated vegetation: *Atriplex confertifolia*, *Artemisia pygmaea*, *Phlox bryoides*, *Sarcobatus vermiculatus*, *Townsendia strigosa*	possible
Cryptantha scoparia	Desert cryptantha	G3, S1, LIST 2	sand and gravelly soil of banks and desert hills; sandy valleys among sandstone caprock; 6,200-7,300 ft. Associated vegetation: *Artemisia* spp., *Gilia* spp., *Petrocarya*	definite
Eriogonum divaricatum	Divergent wild buckwheat	G4G5, S1, LIST 3	clayey soils of desert hills and washes, silty soil; 4,800-7,400 ft. Associated vegetation: *Atriplex confertifolia* and *A. gardneri*	definite
Lesquerella macrocarpa	Large-fruited bladderpod	C2, G2, S2, LIST 1	sparsely vegetated, loose clay soils of flats, slopes, and hills; 7,000-7,800 ft. Associated vegetation: *Atriplex gardneri*, *Sitanion hystrix*, *Phlox bryoides*, *Cymopterus* spp., *Lomatium* spp.	possible
Oryzopsis contracta	Contracted Indian ricegrass	C2, G3, S3, RWL-BLM, LIST 1	plains and hills of western ¾ of State, 6,000 ft. Associated vegetation: *Artemisia tridentata*, *Atriplex* spp., *Opuntia polyacantha*	likely
Oryzopsis swallenii	Swallen mountain ricegrass	3C, G5, S2, LIST 2	rocky knobs and hills, mesa and basin areas, gravelly ridges; 6,600-6,900 ft. Associated vegetation: *Artemisia nova*, *A. tridentata*, *A. arbuscula*	likely

Table 3-16. Special Status Plant Species--Status and Habitat Characteristics, Continued.

Scientific Name	Common Name	Status[2]	Habitat	Probability of Occurrence[3]
Penstemon paysoniorum	Payson beardtongue	3C, G3, S3, LIST 2	sand, raw ground of eroding and nearly barren clay hills, alkaline shaley windswept bluffs, rock crevices, sandy clay gulches, Wasatch Fmn.; 6,500-7,800 ft. Associated vegetation: *Tetradymia spinosa, Chrysothamnus viscidiflorus, Castilleja flava, Haplopappus acaulis, Arenaria hookeri, Stanleya pinnata, Astragalus jejunus, Artemisia arbuscula, Penstemon caespitosus, Senecio canus*	definite
Phlox opalensis	Opal phlox	C2, G1, S1, LIST 1	semibarren desert grassland on clay and clay-derived soils, 6,300-7,000 ft. Associated vegetation: *Artemisia pedatifida, Eriogonum ovalifolium, Arenaria hookeri, Atriplex gardneri, Sphaeromeria argentea*	definite
Phlox pungens	Beaver Rim phlox	C2, G2, S2, LIST 1	sparsely vegetated 30° slope with shale, siltstone, and sandstone platy fragments, silt loam soil over fractured bedrock; 6,635-7,055 ft.; Laney Mbr of the Green River Fmn. Associated vegetation: *Haplopappus acaulis, Poa secunda, Atriplex confertifolia, Cryptantha* spp., *Chrysothamnus nauseosus, Artemisia* spp., *Chaenactis* spp., *Oxytropis sericea, Eriogonum* spp., *Macheranthera grindeloides, Agropyron dasystachyum, A. spicatum*	possible
Physaria condensata	Dense twinpod	3C, G2, S2, LIST 1, S-BLM-RSD	sparsely vegetated calcareous shale knolls, foothills, rocky ridges, and slopes at Green River Shale outcrops; 6,000-7,600 ft. Associated vegetation: *Juniperus* spp., *Penstemon* spp., *Artemisia* spp., *Haplopappus acaulis, Phlox bryoides, Arenaria hookeri, Gilia* spp., *Atriplex confertifolia, A. gardneri, Stanleya pinnata, Eriogonum* spp., *Asclepias* spp., *Oxytropis sericea, Agropyron* spp.	possible
Spiranthes diluvialis	Ute ladies'-tresses	T, G2, S1	floodplains, abandoned stream channels and meanders on permeable materials where soil are saturated to within 18 in. of surface at least temporarily during spring or summer; below 7,000 ft. Associated vegetation: *Equisetum* spp., *Verbena* spp., *Lobelia* spp., *Agrostis stolonifera, Solidago occidentalis, Asclepias* spp., *Melilotus* spp., *Castilleja exilis, Juncus* spp., *Salix exigua, S. lutea, Elaeagnus angustifolia, Alnus tenuifolia*	possible

1 - Sources: WYNDD 1994a; Fertig 1994; USDI-FWS 1994b; Weynand and Amidon 1990; USDI-BLM 1994c.

2 - Definition of status

Table 3-16. Special Status Plant Species--Status and Habitat Characteristics, Continued.

Federal Status

E	Federally Listed Endangered. Species, subspecies, or populations that are threatened with extirpation or extinction resulting from very low or declining numbers, alteration and/or reduction of habitat, detrimental environmental changes, or any combination of the above. Continued long-term survival is unlikely without implementation of special measures.
T	Federally Listed Threatened. Species likely to become endangered in the foreseeable future throughout all or a significant portion of its range.
P	Federally Proposed for Listing. Species that are proposed for listing as threatened or endangered.
C1	Federal Category 1 Candidate species. Species for which there is substantial information on file on the biological vulnerability and threats to support the appropriateness of proposing to list taxa as an endangered or threatened species.
C2	Federal Category 2 Candidate species. Species for which there is some evidence of vulnerability but for which there are insufficient data to support listing and for which additional study is needed.
3C	Federal Category 3C Candidate species. Species that have been found to be more abundant or widespread than had been previously believed, and/or those that are not subject to identifiable threats that place the continued existence of the species at risk.

Global Rank/Definition

G1	Critically imperiled globally because of extreme rarity (5 or fewer occurrences or very few remaining individuals) or because of some factor of its biology that makes it especially vulnerable to extinction (Critically endangered throughout range).
G2	Imperiled globally because of rarity (6 to 20 occurrences) or because of other factors demonstrably making it very vulnerable to extinction throughout its range (Endangered throughout range).
G3	Either very rare and local throughout its range or found locally (even abundant at some of its locations) in a restricted range, or because of other factors making it vulnerable to extinction throughout its range (21 to 100 occurrences; Threatened throughout its range).
G4	Apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery.
G5	Demonstrably secure globally, though it may be quire rare in parts of its range, especially at the periphery.

State Rank

S1	Critically imperiled in Wyoming because of extreme rarity (5 or fewer occurrence, or very few remaining individuals) or because of some factor of its biology making it especially vulnerable to extinction (Critically endangered in State).
S2	Imperiled in Wyoming because of rarity (6 to 20 occurrences) or because of other factors demonstrably making it very vulnerable to extinction throughout its range (Endangered in State).
S3	Rare in Wyoming (on the order of 20+ occurrences) (Threatened in State).
S4	Apparently secure in Wyoming.
S5	Demonstrably secure in Wyoming.

Other Codes

T	Rank for a subspecific taxon (species or variety); appended to the global rank for the full species.
?	Assigned status questionable.
RWL	Recommended for the Watch List for a given resource area of the Bureau of Land Management (PRRA - Platte River Resource Area).

Wyoming Natural Diversity Data Base

LIST 1	Highest priority
LIST 2	Medium priority
LIST 3	Lowest priority

3 -	Probability based on presence of habitat and known distribution.

examination of prairie dog colony characteristics and distribution within the analysis area is presented in the Wildlife Technical Report (HWA 1994). Although no recent evidence exists which indicates occupation of the analysis area by black-footed ferrets, numerous sightings of ferrets have been recorded within and in close proximity to the analysis area within the last decade (WGFD 1992b). A total of seven probable sightings of

Table 3-17. Threatened or Endangered Wildlife Species Potentially Present in the Moxa Analysis Area.

Species	Scientific Name	Status
Mammals		
Black-footed ferret	*Mustela nigripes*	Endangered
Birds		
Bald eagle	*Haliaeetus leucocephalus*	Endangered
Whooping crane	*Grus americana*	Endangered
Peregrine falcon	*Falco peregrinus*	Endangered

Table 3-18. Candidate Wildlife Species Potentially Present in the Analysis Area.

Species	Scientific Name	Category
Mammals		
Preble's shrew	*Sorex preblei*	2
Pygmy rabbit	*Brachylagus idahoensis*	2
Birds		
White-faced ibis	*Plegadis chihi*	2
Ferruginous hawk	*Buteo regalis*	2
Mountain plover	*Charadrius montanus*	1
Long-billed curlew	*Numenius americanus*	3C
Black tern	*Chlidonias niger*	2
Loggerhead shrike	*Lanius ludovicianus*	2
Burrowing owl	*Athene cunicularia*	2

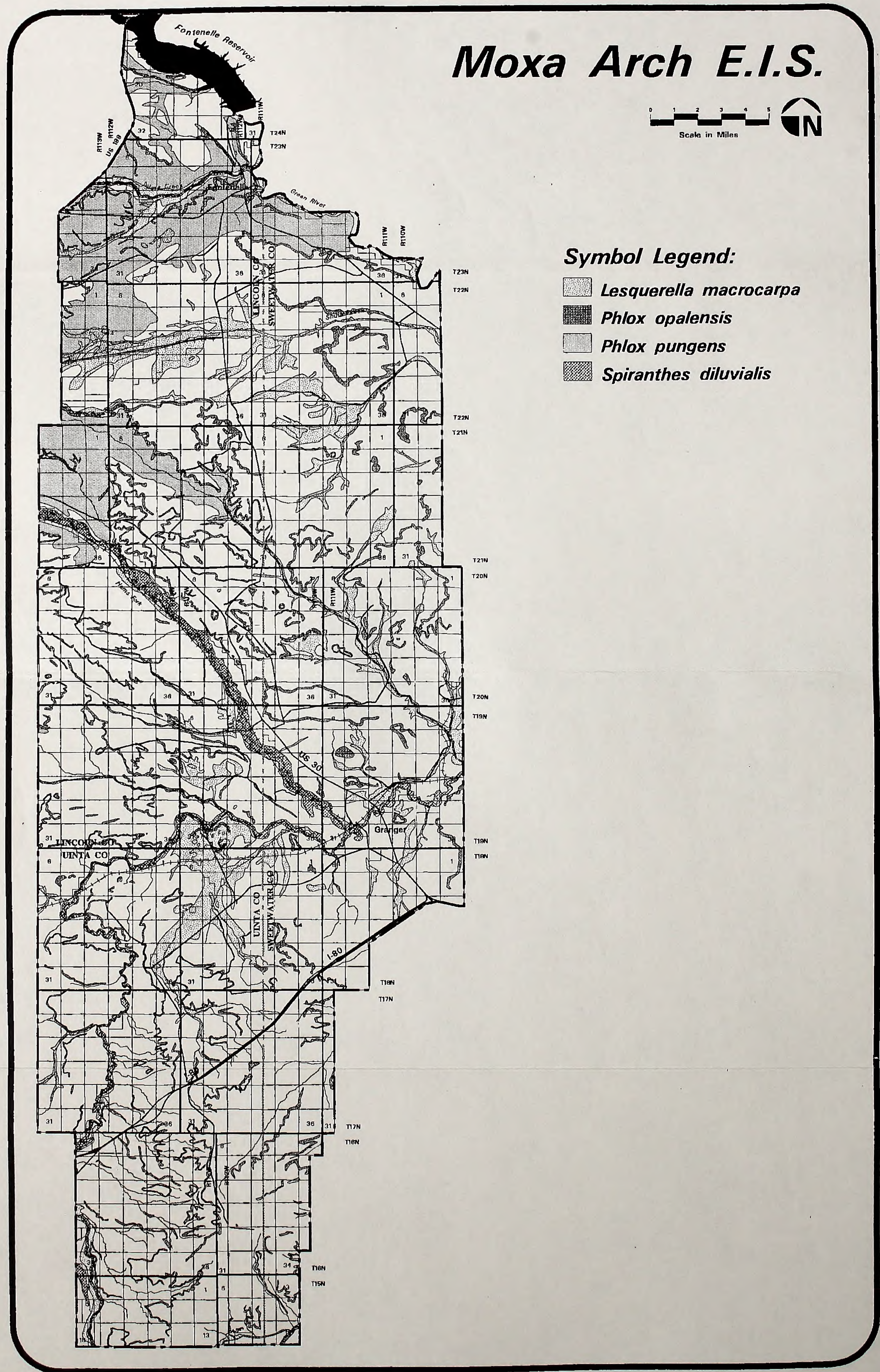

Exhibit 3-13. Potential Habitat Areas for Special Status Plants (Federally Listed and Candidate Category 2 Species).

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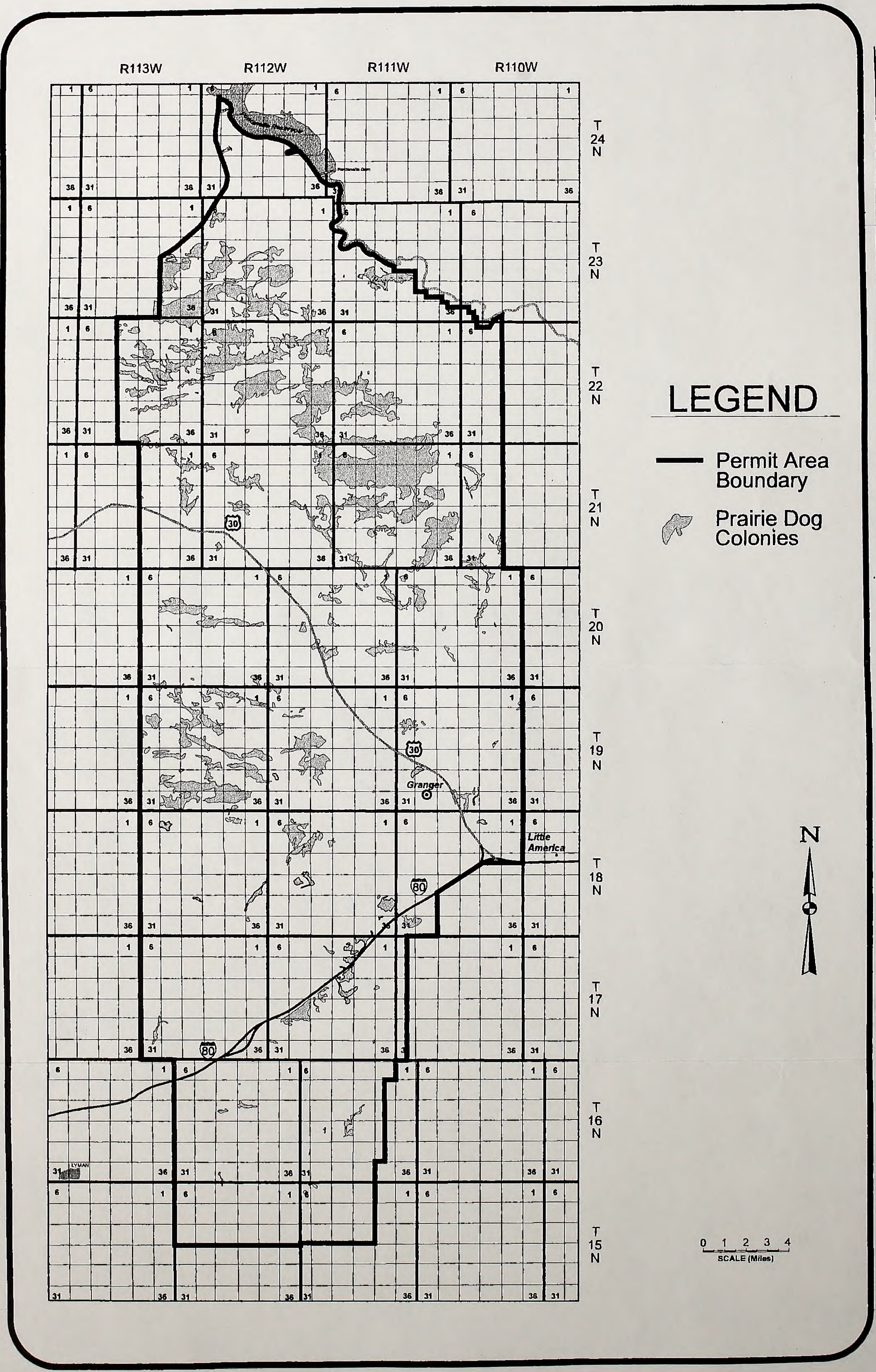

Exhibit 3-14. Location of White-Tailed Prairie Dog Colonies on the Proposed Expanded Moxa Analysis Area.

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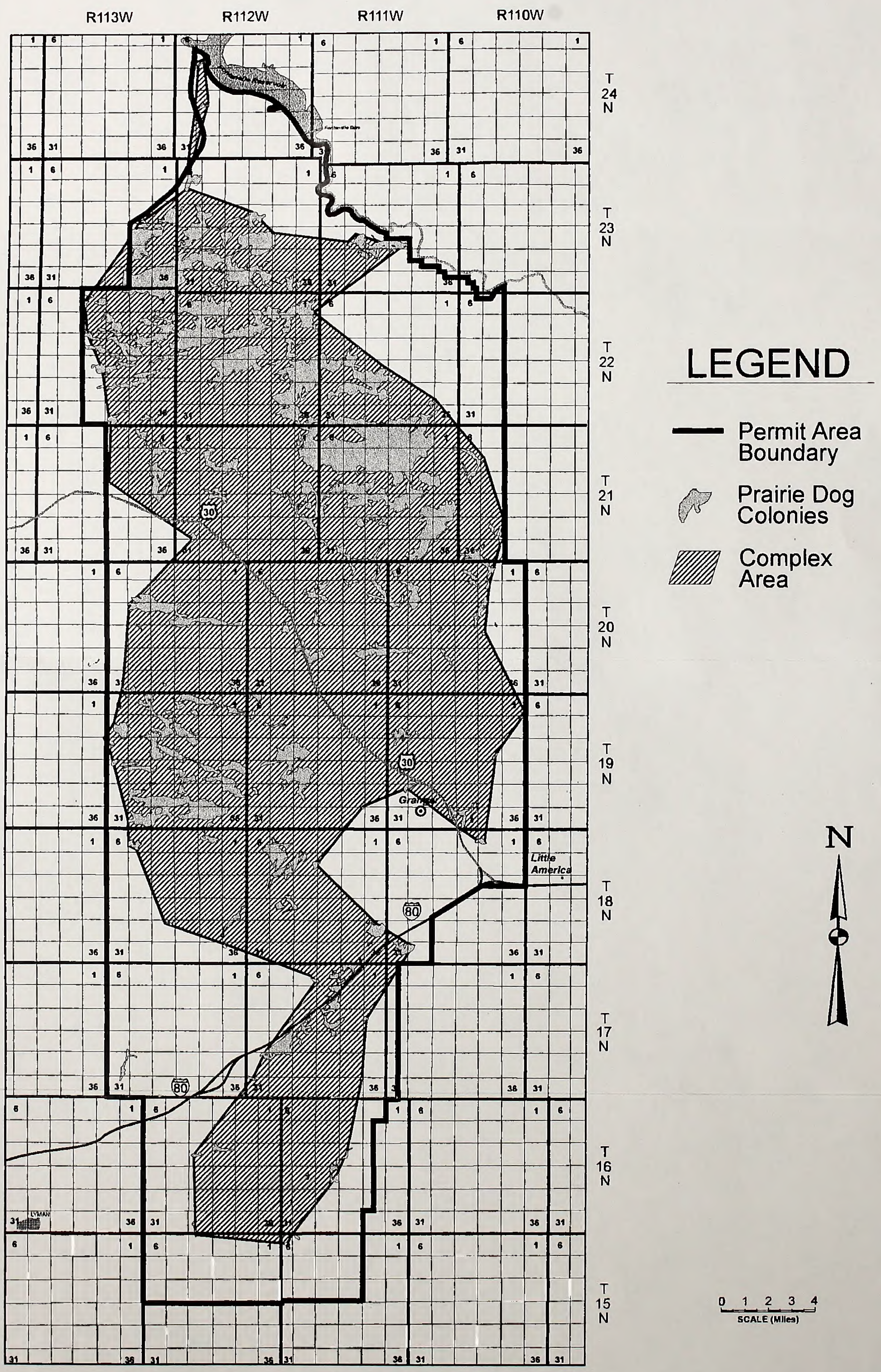

Exhibit 3-15. Prairie Dog Complex (as defined by the FWS) on the Proposed Expanded Moxa Analysis Area.

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black-footed ferrets within the analysis area have been documented by the WGFD; the most recent of these was reported in 1986. Considering this record of historical sightings, along with the vast amount of optimal habitat within the analysis area, the possible occurrence of the black-footed ferret in this area cannot be ruled out.

Bald Eagle. Bald eagles typically build stick nests in the tops of coniferous or deciduous trees along streams, rivers or lakes; they may also select cliffs and ledges as nest substrates (Call 1978). Selection of nest trees appears to depend, in part, on food availability early in the nesting season (Swenson et al. 1986). Primary wintering areas are typically associated with concentrations of food sources: along major rivers that remain unfrozen where fish and waterfowl are available and near ungulate winter ranges (Montana Bald Eagle Working Group 1990). Wintering bald eagles are known to roost near concentrations of domestic sheep and big game in forests with large, open conifers and snags often protected from winds by ridges (Anderson and Patterson 1988).

Although no bald eagles were observed within the analysis area during field surveys, WOS data suggest that bald eagles are common winter residents along the Green River from the Fontenelle Reservoir southeastward into the Seedskadee National Wildlife Refuge (NWR). In addition, bald eagles have been reported to nest along portions of the Green River to the east and north of the analysis area (WGFD 1994; WYNDD 1994b). This area is a potentially good wintering area for eagles due to the fact that portions of river remain open and there are ample concentrations of fish, waterfowl, and ungulates throughout the winter months.

Whooping Crane. Whooping crane breeding and wintering habitats have been described for the sub-population that nests within the Wood Buffalo National Park and winters on the Arkansas NWR along the Gulf of Mexico in Texas (Whooping Crane Recovery Team 1986). Most cranes in the sub-population introduced at Grays Lake NWR spend summers throughout eastern Idaho and western Wyoming and spend winters in the vicinity of Bosque Del Apache NWR in west-central New Mexico (Whooping Crane Recovery Team 1986). Habitats used include marshes and swamps, wet meadows, and grain fields near water (Dorn 1981). Similar wetlands habitats are used by migratory whooping cranes along the North Platte River in Nebraska (Aronson and Ellis 1979).

Each pair of whooping cranes requires about 1,000 acres of undisturbed marsh for nesting and about 400 to 600 acres for winter feeding (Mackenzie 1977). Wetlands are extremely limited within the Moxa analysis area and the possibility of a whooping crane using the area is remote. Although there have been 12 documented sightings of whooping cranes in areas peripheral to the analysis area between 1981 and 1986, there have been no documented sightings on or near the Moxa area since 1986 (WGFD 1994; WYNDD 1994b). The potential for whooping crane use of this region has been greatly reduced by the termination of the cross-fostering program at Greys Lake NWR in Idaho.

Peregrine Falcon. Nesting habitat of the peregrine falcon usually is on a cliff face 200 to 300 feet high, but cliffs as high as 2,100 feet have been used. Most known nest sites are below 9,500 feet elevation, but nests located as high as 10,500 feet have been documented (USDI-FWS 1984). An available prey base of shorebirds, waterfowl, and/or small- to medium-sized terrestrial birds usually occurs within ten miles of the nest site. Wetlands and riparian zones, as well as open meadows, parklands, croplands, lakes and gorges are potential habitats in which prey bird species are found and easily hunted by peregrines. Nesting peregrines may, however, hunt up to 17 miles from their aerie to locate prey (USDI-FWS 1984).

Bird populations on the analysis area appear to be abundant and diverse enough to support peregrines and some of the cliffs located through the central and along the southern portions of the analysis area are high enough to provide suitable nesting habitat. In spite of the presence of what appears to be suitable habitat, HWA biologists observed no peregrine falcons within the analysis area during 1994 surveys (HWA 1994), and neither the WOS nor the WYNDD contain sighting records. It is likely that peregrine falcons make occasional use of the analysis area during spring and fall migration periods.

Preble's Shrew. No observations of Preble's shrew were made in the analysis area during field surveys (HWA 1994) nor were there any documented occurrences in the WOS or WYNDD. According to the literature, Preble's shrews have been collected mostly in semiarid habitats dominated by sagebrush or shrub-grasslands associated with ephemeral water sources (Hoffmann and Fisher 1978). Only recently, it was discovered that a specimen collected in southeast Uinta County was Preble's shrew (Tamasi and Hoffmann 1984) as it had been misclassified earlier (Long 1965) as a masked shrew. Although no trapping was initiated for small mammals, and the obtrusive nature of the species makes observations difficult, available literature suggests that the shrew is unlikely to be present within the analysis area.

Pygmy Rabbit. Pygmy rabbits are apparently quite common within the analysis area as 17 individual sightings were made during the field surveys (HWA 1994). Over 80 percent (14) of these sightings were confined to the northern half of the analysis area. As many as 11 additional sightings of pygmy rabbits were reported within the analysis area in the WYNDD and nearly all were confined to the northern half as well. Little is known about their habitat requirements, but the limited literature available suggests that they are primarily confined to dense stands of big sagebrush (Campbell et al. 1982; Green and Flinders 1980; Fisher 1979). This is corroborated by field observations which suggest that pygmy rabbits show an affinity for areas with dense stands of big sagebrush and relatively sandy soils (HWA 1994). Campbell et al. (1982) suggest that the former range of the pygmy rabbit has been limited primarily to portions of Idaho and Utah, and they have only recently extended their range into southwestern Wyoming. Although their range has likely expanded in the past, they have probably been present in isolated locals for quite some time. Only recently, have biologists begun to take notice of the species, thus their documented presence throughout portions of the State has become more commonplace.

White-Faced Ibis. White-faced ibises feed in wet meadows and shallow water found along streams and lakes. They nest in areas with extensive water, which is required for successful reproduction, and build their nests in heavy emergent vegetation such as cattail and reed (Dinsmore 1983).

No white-faced ibises were seen in the analysis area during the period of field surveys conducted (HWA 1994). However, the WOS provides documentation of at least five occurrences within the analysis area. The most recent of these was reported in 1989 near the central portion of the analysis area along the Blacks Fork River. In addition, numerous other accounts are reported for the white-faced ibis along the Green River to the north, directly adjacent to the analysis area. Extensive water and emergent vegetation are rare within the analysis area, and ibis use beyond casual migratory resting and feeding is greatly limited.

Ferruginous Hawk. Throughout their range, ferruginous hawks have been documented nesting on a wide variety of substrates (Evans 1983). In Utah for example, ferruginous hawks nested on junipers, pinyon pines, cottonwoods, on the ground, low hills and knolls, low cliffs, and on artificial structures (Smith and Murphy 1973). Generally, this species nests where visibility is extensive and this, in part, may contribute to the species' relatively high sensitivity to human disturbance (Suter and Joness 1981; Taylor 1988). In the analysis area, the ferruginous hawk stick nests are typically located on rock outcrops which are elevated from the surrounding terrain. These hawks lay eggs from mid-March through early April and the young fledge from early June to early July (Call 1978).

Ferruginous hawk sightings were relatively common throughout the analysis area, although only 14 nests were identified. Numerous individual sightings of ferruginous hawks have been documented for the area by the WOS as well. A total of 67 buteo nests of unknown origin were discovered during field surveys (HWA 1994) and it is possible that many of these nests are those of ferruginous hawks.

Mountain Plover. The mountain plover prefers open, level or slightly rolling areas dominated by blue grama and buffalograss (Dinsmore 1983). Such areas are also characteristic of white-tailed prairie dog habitat, which explains why the mountain plover was almost exclusively seen within or near prairie dog colonies (HWA 1994).

Fifteen individual sightings of mountain plover were made while conducting field surveys on the analysis area (HWA 1994). Although no additional sightings are reported for the analysis area in the WOS, several observations of mountain plover have been made directly adjacent to the analysis area. Potentially good nesting and foraging habitat exist for mountain plover on the analysis area. The presence of numerous juvenile birds in the analysis area confirms their nesting within the analysis area.

Long-Billed Curlew. Long-billed curlews prefer nesting in arid regions of grassland and shrub habitats of the western plains. Curlews build their nests in shallow scrapes on the ground, and although they may nest several kilometers from water, nests are usually located within close proximity to open lakes and sloughs (Dinsmore 1983).

No long-billed curlews were observed on the analysis area during field surveys (HWA 1994). However, the WOS contains documentation of a single sighting of a long-billed curlew within the analysis area directly adjacent to the Seedskadee NWR. Additional sightings of long-billed curlews have been reported in the WOS for areas proximal to the southwest and northeast corners of the analysis area. The most recent of these was reported in 1991. Some marginal habitat for curlew nesting and migration is available within the analysis area; however, optimum habitat is limited primarily by the relative absence of permanent wetland areas.

Black Tern. No black terns were seen within the analysis area over the course of field surveys (HWA 1994), and there have been no recorded sightings within the analysis area as reported in either the WOS or the WYNDD. The WOS does, however, contains documentation of at least five occurrences of black terns along the Green River directly adjacent to the northeast corner of the analysis area.

The black tern requires small to large marshes with extensive stands of emergent vegetation for nesting, and often builds nests on muskrat houses (Johnsgard 1986). There is little suitable nesting habitat within the analysis area. There have been no documented sightings since 1982, and their continued presence within the region seems unlikely.

Loggerhead Shrike. Despite its listing as a C2 candidate species, the loggerhead shrike was observed frequently throughout the analysis area during field surveys (HWA 1994). Eighty-five individual sightings of loggerhead shrikes were made throughout the analysis area, and many of these consisted of juvenile birds. The majority of sightings were confined to the central portion of the analysis area from T19N to T21N. The frequency and distribution of sightings of loggerhead shrikes on the analysis area is comparable to those reported in the WOS for the same region.

For nesting and feeding, loggerhead shrikes prefer open country within close proximity to brushy areas containing trees or shrubs taller than six feet (Dinsmore 1983). These types of areas are specific to many of the dense stands of sagebrush found throughout much of the analysis area, and it is likely that loggerhead shrikes nest throughout the analysis area in moderate numbers.

Burrowing Owl. The burrowing owl was found on the analysis area and has only recently been listed as a candidate species by the FWS (USDI-FWS 1994a). The species is also classified as rare by the WGFD.

Thirty-seven individual sightings of burrowing owls were made in the analysis area during field surveys conducted during July and August (HWA 1994). Most sightings (29) were confined to the northern half of the analysis area where prairie dog colonies were the densest. Nearly one-third of the sightings (11) were of active nest burrows where two or more birds were seen together.

3.10.3 Special Status Fish

Endangered fish species that are listed as species of concern by the FWS (USDI-FWS 1994a; Appendix A of HWA 1994), and which may occur within perennial streams in the Moxa analysis area and downstream from the analysis area in the mainstem of the Colorado River are included in Table 3-19.

Colorado Squawfish. The Colorado squawfish was included in the first List of Endangered Species issued by the Office of Endangered Species and published in the Federal Register (32 FR 4001) on March 11, 1967. It receives protection under the ESA and a recovery plan which was developed for the species in 1978 and subsequently revised in 1990 (USDI-FWS 1990a).

The Colorado squawfish is endemic to the rivers and large tributaries of the Colorado River Basin. It is extinct in the lower basin below Glen Canyon Dam where it was apparently once abundant (Seethaler 1978). In the upper basin, the species is found in the Green River Sub-basin and its tributaries, the Yampa, White and Little Snake Rivers; and in the Colorado River Sub-basin and its tributary, the Gunnison River. The species has recently been found in the San Juan River Sub-basin. Causes for decline include construction of mainstem dams, altered river flows, altered water

Table 3-19. Listed Fish Species That May Occur within the Moxa Analysis Area.

Species	Scientific Name	Status
Colorado squawfish	*Ptychocheilus lucius*	Endangered
Humpback chub	*Gila cypha*	Endangered
Bonytail chub	*Gila elegans*	Endangered
Razorback sucker	*Xyrauchen texanus*	Endangered

chemistry and water temperature, and introduction of exotic fishes (USDI-FWS 1990a).

The Green River Sub-basin supports the largest subpopulation of Colorado squawfish, where documented reproduction has been consistent for the last ten to 15 years (Holden and Wick 1982). Historic range includes the Green River as far upstream as the City of Green River, Wyoming. However, the species has not occurred above the confluence with the Yampa River since the construction and closure of Flaming Gorge Dam in 1962 (Ono et al. 1983).

Colorado squawfish inhabit turbulent stretches of river with seasonally variable flow and high silt loads. Adult Colorado squawfish in the upper basin congregate to spawn in July and August at water temperatures of 18° to 22°C. Radiotelemetry studies (Tyus and McAda 1984) have linked defined movements of adult squawfish with spawning in areas of the Green and Yampa rivers. Incubation time for the eggs is only five to six days, and the larvae are transported by river currents to quiet backwaters in downstream nursery areas. Sufficient river flow to form these backwaters is critical to the survival of a given year class. The young fish remain in these backwaters for about one year and then move to various habitats of the main channel. Juveniles and adults are exclusively piscivorous and occupy a variety of riverine habitats.

Humpback chub. The humpback chub was included in the first list of Endangered Species issued by the Office of Endangered Species and published in the Federal Register (32 FR 4001) on March 11, 1967. It is protected under the ESA and a recovery plan, which was first developed for the species by the Colorado River Fishes Recovery Team in 1979, and was subsequently revised in 1990. The recovery priority for the humpback chub is ranked as 2C, which indicates a high degree of threat and a high recovery potential for a species in conflict with some form of economic development (USDI-FWS 1990b).

The humpback chub is endemic to the rivers and large tributaries of the Colorado River Basin, where it was once apparently locally abundant. Today, the species is found primarily in six areas--one in the Little Colorado River of the lower basin, and five in the upper basin--Black Rocks and Westwater canyons of the Colorado River Sub-basin; Desolation Canyon of the Green River Sub-basin; Yampa Canyon of the Yampa River; and Cataract Canyon below the confluence of the Green and Colorado Rivers. The decline of the humpback chub is due to a combination of factors, including dam construction, flow depletion, competition with non-native fishes, and hybridization with other fish of the same genus.

Historic range includes the Green River as far upstream as Flaming Gorge, Wyoming. The species has not occurred above the confluence with the Yampa River since the construction and closure of Flaming Gorge Dam in 1962 (Ono et al. 1983).

Adult humpback chub in the upper basin are found in a variety of habitats and are relatively sedentary (Valdez and Clemmer 1982). They are generally restricted to deep, swift riverine regions characterized by rocky shoreline and substrate. Humpback chub generally spawn at water temperatures of 11.5° to 17°C. Little is known about this activity since it occurs close to spring runoff when the river is swift and turbulent. The eggs incubate for only eight to ten days, and unlike the Colorado squawfish, larvae of the humpback chub are apparently not transported great distances downstream by river currents. The young chubs are reared in nearby shallow areas, including backwaters, and the juveniles and adults occupy deep areas of low velocity, but often close to swift currents. Juveniles and adults are insectivores and detritivores and generally remain in specific areas within the riverine regions described.

Bonytail Chub. The bonytail chub has been classified by the FWS as an endangered species since 1980. The recovery priority for the bonytail chub is ranked as 5C, which indicates a high degree of threat and a low recovery potential for a species which is in conflict with some form of economic development (USDI-FWS 1990c). Of the four species of endangered fish considered in this analysis, the status of the bonytail chub is the most critical and, unless heroic efforts for its preservation are exerted, its extinction is probable (Ono et al. 1983).

The bonytail chub once ranged throughout most of the Colorado River Basin and as far north as Wyoming where it was found in the Green River. The disappearance of this species throughout most of its original range is attributed to the construction of major dams (Flaming Gorge, Hoover, Glen Canyon and more than 17 others), flow depletion from irrigation and other sources, hybridization with other fish of the same genus (USDI-FWS 1990c), and the introduction of non-native fishes (Ono et al. 1983). Between 1926 and 1950 this fish disappeared from nearly all of its original habitats in the lower Colorado River and, according to the FWS, "exhibited the most abrupt decline of any of the fishes native to the mainstreams of the Colorado River System" (Ono et al. 1983).

The bonytail chub has been primarily considered as a mainstream river species and is found in areas around pools and eddies rather than areas with higher current (Vanicek 1967). The bonytail chub requires warm water and will not spawn in water temperatures below 65°F. This requirement may be an important factor in the decline of the species and appears to be the cause of its disappearance in the Green River in Wyoming as the chub disappeared following the construction of the Flaming Gorge Dam, which caused the previously warm river to be modified into a cold-water reservoir (Ono et al. 1983).

The current distribution of the bonytail chub is limited to a few survivors in the non-impounded portions of the Colorado River system and a population of old individuals in Lake Mohave. This species has been extirpated from the Green, Gunnison, Yampa, Salt, and Gila Rivers where it was once common (Ono et al. 1983).

Despite the contention of its disappearance from the Green River system, at least six occurrences of the bonytail chub have been reported by the WYNDD. These occurrences were reported in both the Green River and Blacks Fork River; the most recent occurrence was in 1979. These individuals are not likely to comprise a self-sustaining population, but rather comprise a remnant population of fish which became isolated after the construction of the Flaming Gorge Dam in 1962. This is supported by the fact that bonytails can live upwards of 50 years and there have been no reported occurrences of boneytails within the upper Green River system since 1979. Given these circumstances, their continued presence within the analysis area seems unlikely.

Razorback Sucker. Although the distribution of the razorback sucker is now limited to small segments of river in the upper basin waters of the Colorado and Green Rivers, it historically occurred from Wyoming to Mexico throughout the Colorado River and major tributaries (Ono et al. 1983). This species currently occurs in the Green River only downstream from the Flaming Gorge Dam. It was eliminated from the upper Green River in about 1962 when this stretch of river and its tributaries were treated with rotenone, a poison to fish. Razorbacks prefer warm flowing water, and the waters of Flaming Gorge Reservoir and the tailwaters below the dam are too cold to provide suitable habitat for this species.

The disappearance of the razorback sucker from much of its original range is thought to be due to the construction of high dams that have produced deep, cold waters that are unsuitable habitat for this species. In other parts of its original range, water diversion and irrigation developments have dewatered and temporarily dried up stretches of river that previously provided suitable habitat. The creation of such an extensive series of dams may also have disrupted the normal spawning migrations of the razorback and caused a reduction in successful reproduction. Another factor that may have reduced reproductive success of the razorback sucker was the introduction of non-native fish species into the razorback's habitat. Introduced species such as the red shiner, channel catfish, and largemouth bass may consume sufficient quantities of the razorback's fry to significantly limit reproductive success (Ono et al. 1983).

Fish species which are not listed as endangered or threatened but have been set forth by the FWS for possible listing in the future are classified as candidate species. The FWS has determined that three species, listed as candidate species by the ESA are potentially present in the Colorado River System (USDI-FWS 1994a; Appendix A of HWA 1994). The three candidate species, and their federal status under the ESA, are included in Table 3-20.

Flannelmouth Sucker. The flannelmouth sucker is one of the most abundant and widely distributed candidate fish species of the tributaries and mainstream portions of the upper Colorado River Basin (Tyus et al. 1982). This species is found primarily in the Yampa, Little Snake, Colorado, and Gunnison rivers. Causes for their decline include construction of mainstream dams, altered river flows and water temperatures, and hybridization with the white sucker (Minckley 1973).

Despite its importance as a native species endemic to the Colorado River Basin, there is little information on the life history of this species. The little information available suggests the flannelmouth sucker utilizes habitats in moderate to large rivers, is seldom found in smaller creeks, and does poorly in impoundments (Lee et al. 1980). This species spawns in riffles, usually over a substrate of course gravel (Lee et al. 1980). The flannelmouth sucker is primarily a bottom feeder, feeding on diatoms, algae, fragments of higher plants, and benthic invertebrates (Sigler and Miller 1963; Lee et al. 1980).

At least nine occurrences of the flannelmouth sucker have been reported by the WYNDD for the analysis area. Flannelmouth suckers were reported to occur in the Green River, Blacks Fork River, and the Hams Fork River as recently as 1981. Like the bonytail chub, it is possible that these individuals comprise a remnant non-viable population that have become isolated as a result of the construction of the Flaming Gorge dam, but their continued presence within the Green River system cannot be ruled out.

Roundtail Chub. The roundtail chub was apparently never common or widespread throughout most of the Colorado River Basin. Factors that contributed to the species decline include dam construction and subsequent habitat alterations, competition with non-native species, and hybridization with other species of chub.

Roundtail chub are found in relatively warm streams and larger tributaries of the Colorado River Basin (Lee et al. 1980). The roundtail chub likely inhabits areas of similar water temperatures as the closely related subspecies, the endangered Pahranagat roundtail chub, which is found in water temperatures that range from 59° to 86°F, but is most often associated with water temperatures below 77°F (USDI-FWS 1985).

Adult roundtail chub move upstream to spawn in gravel or cobble substrates in pools and moderate velocity water (Sublette et al. 1990) during late spring and early summer. Roundtail chub exhibit spawning behavior similar to most other species of chub. Young fish feed almost exclusively on a diet of macroinvertebrates whereas adults feed almost entirely on algae (Greger and Deacon 1988).

3.11 VISUAL RESOURCES

The following description of the affected environment is based on the BLM's land classification program for visual resources, Visual Resource Management (VRM) (USDI-BLM 1980). Seldom-seen areas were delineated on USGS quad maps by identifying ridgelines or sharp breaks in contour as seen from major roads in the analysis area. The collective outlines describe the viewsheds from all major roads and the railroad. Objects and activities within a viewshed would generally be visible. These initial delineations were field-checked by traveling all major roads in both directions. Two on-site visits and interpretive work from topographic maps, photographs, and field notes compiled by other interdisciplinary team (IDT) members were utilized to describe the affected environment.

3.11.1 Landscape Description

The visual characteristics of the analysis area are typical of the cold desert steppe of southwest Wyoming. Sightlines are long and the visual absorption capacity is

Table 3-20. Candidate Fish Species Potentially in the Colorado River System.

Species	Scientific Name	Category
Flannelmouth sucker	*Catostomus latipinnis*	2
Roundtail chub	*Gila robusta*	2
Leatherside chub	*Gila copei*	2

low. Only an estimated 192 square miles of the 748 square miles in the analysis area were identified as being Seldom Seen from a major highway, Fontenelle Reservoir, the Green River, or the railroad used by Amtrak. The characteristic landscape is gently undulating, with occasional badland breaks that stand out as contrasting forms. Small drainages dissect the landscape adding visual diversity. Greasewood dominates in the lower depressions. Relatively flat areas typically have a homogeneous vegetative cover of low sagebrush and grass. The density of sagebrush varies depending on aspect and soil conditions.

There are very few trees in the analysis area. What few there are grow along the Hams Fork, Blacks Fork, the Green River and the canals fed by these rivers. Irrigated lush green pasturelands along these rivers are a dominant feature in the landscape in locations where they are visible. The diverse mosaic of vegetation and topography is characteristic of the analysis area. Green and gray-green are the predominate colors during spring. The gray-green of sagebrush and buff and ocher colors of curing grass dominate in the fall. Winter snow accentuates the patterns of the shrub community. Buff, brown, tan, gray, and rust are the dominant colors of the soils and badland breaks.

Evidence of culture modification to the characteristic landscape include ranches, communities, oil and gas production facilities, snow fence, billboards, powerlines, fences, roads, railroads, and communication towers. Many of these features are noticeable as contrasts in line, form, color, and texture when seen in relation to the adjacent undisturbed landscape.

Table 3-21 identifies and describes the characteristic landscape and the degree of cultural modifications evident in the seven specific viewsheds delineated for the analysis area.

3.11.2 Analysis

Motorists traveling I-80, U.S. 30, and U.S. 189--the most heavily traveled routes--would have visual access to an estimated 556 square miles of the analysis area. Amtrak train passengers would be able to see into approximately 263 square mile of the analysis area. For some of these travelers, particularly tourists, the quality of the visual resources is an important component of the traveling experience. Of the 556 square miles visible from the major routes, an estimated 116 square miles are in the foreground of the viewshed (within one mile of the viewer).

There are four formal recreations sites and the Seedskadee NWR adjacent to the analysis area. The analysis area receives a low to moderate level of use by recreationists, including big game and upland game hunters, wildlife watchers, off-road vehicle (ORV) enthusiasts, and some backpackers and hikers along the Oregon Trail. Fishermen on Fontenelle Reservoir and the Green River, as well as pronghorn hunters in the analysis area, constitute the largest segment of the user population. The quality of the visual resources is typically an aspect of concern for these groups of users. Other users, including those working in the oil and gas industry, ranchers, as well as grazing permit holders, would also be affected by changes to the visual resource.

The intent of the BLM's VRM program is to preserve scenic values in concert with resource development.

Visual resource specialists with BLM have classified the visual resources in the analysis area as Class II, Class III and Class IV as shown in Exhibit 3-16. The glossary defines the levels of change to the visual resource permitted in Class II, Class III, and Class IV landscapes (USDA-BLM 1980).

Table 3-21. Viewsheds within the Moxa Analysis Area.

Viewshed	Location	Description of Features
Viewshed 1	WY 240: Opal to U.S. 189	Several broad valleys are important visual features. The level of cultural modification is relatively low.
Viewshed 2	U.S. 189: Junction of WY 240 to Fontenelle Reservoir	Wet meadow and playa riparian areas are visually predominant in several locations. Fontenelle Reservoir is a dominant visual feature. Segments of the analysis area are visible from the Fontenelle Creek Recreation Area--a major camping and boating facility in the region.
Viewshed 3	WY 372 to Fontenelle Dam	This segment of WY 372 and the viewshed are part of the Oregon Trail Tour Route. Sixteen oil and gas facility sites are visible. Three campgrounds and a boat launch facility exist in the vicinity of the dam. The level of cultural modifications is moderate to high.
Viewshed 4	WY 312: Junction of U.S. 189 to Seedskadee National Wildlife Refuge	Gently sloping expansive area of low sagebrush dominate this viewshed. Several segments of the analysis area would be visible as middleground and background from Seedskadee National Refuge. The existing level of cultural modification is low.
Viewshed 5	U.S. 30: Opal to I-80	This viewshed is the most diverse of any in the analysis area. Where visible, the irrigated pastureland along Hams Fork and the enclosing badland bluffs are dominant landscape features. Evidence of the cultural modification is high. Seventy existing well sites and five new sites are visible from U.S. 30, as is the community of Granger.
Viewshed 6	WY 412: I-80 to U.S. 189	Periodic distance views into the analysis area are possible south of Carter, Wyoming.
Viewshed 7	I-80: Lyman exit to Little America	Badlands dominate this viewshed. Views of any particular area for a moving observer are generally of short duration, because of intervening topography. Evidence of cultural modification is moderate to high. Forty well sites, a refinery tank farm, and several billboards are visible from I-80. Residents living east of Lyman near the project boundary would have visual access into the analysis area. Lyman and Mountain View residents would also be able to view any well field development on the west edge of the butte north of Big Dry Creek.

For a Class II area, any contrasts in form, line, color or texture should not be evident or attract attention. The estimated area in this class is 30 square miles. For a Class III area, projects can contrast with the basic elements present and may draw a casual viewer's attention, but they should not dominate the existing landscape. The estimated area in Class III is 145 square miles. For a Class IV area, projects that contrast enough to attract attention and dominate the landscape are allowed, but they should be constructed in a manner that they blend as much as possible with the surrounding landscape. The estimated area in this class is 573 square miles.

Currently, I-80 has a visual character of Common Natural/Human Induced, with some areas of Human Dominated. U.S. 189 has a Common Natural, possible Common Natural/Human Dominated visual character. U.S. 30 is Common Natural, Common Natural/Human Dominated, with possible Human Dominated visual character. Existing gas development in the Moxa analysis area has exceeded the VRM objectives in some areas.

3.12 NOISE

Other than vehicle traffic on I-80, U.S. 30, and U.S. 189; jet aircraft overflights at high altitudes; and localized vehicular traffic on two-track roads in the analysis area, only drilling and production operations-related traffic going to and from the analysis area and on-going drilling and production operations create even modest sound disturbances within, and in the immediate vicinity of, the Moxa analysis area.

3.13 RECREATION

Recreation use of public and private lands within the Moxa analysis area primarily involves dispersed activities. However, there are developed recreation sites and facilities adjacent to the analysis area at Fontenelle Reservoir and at several locations along the Green

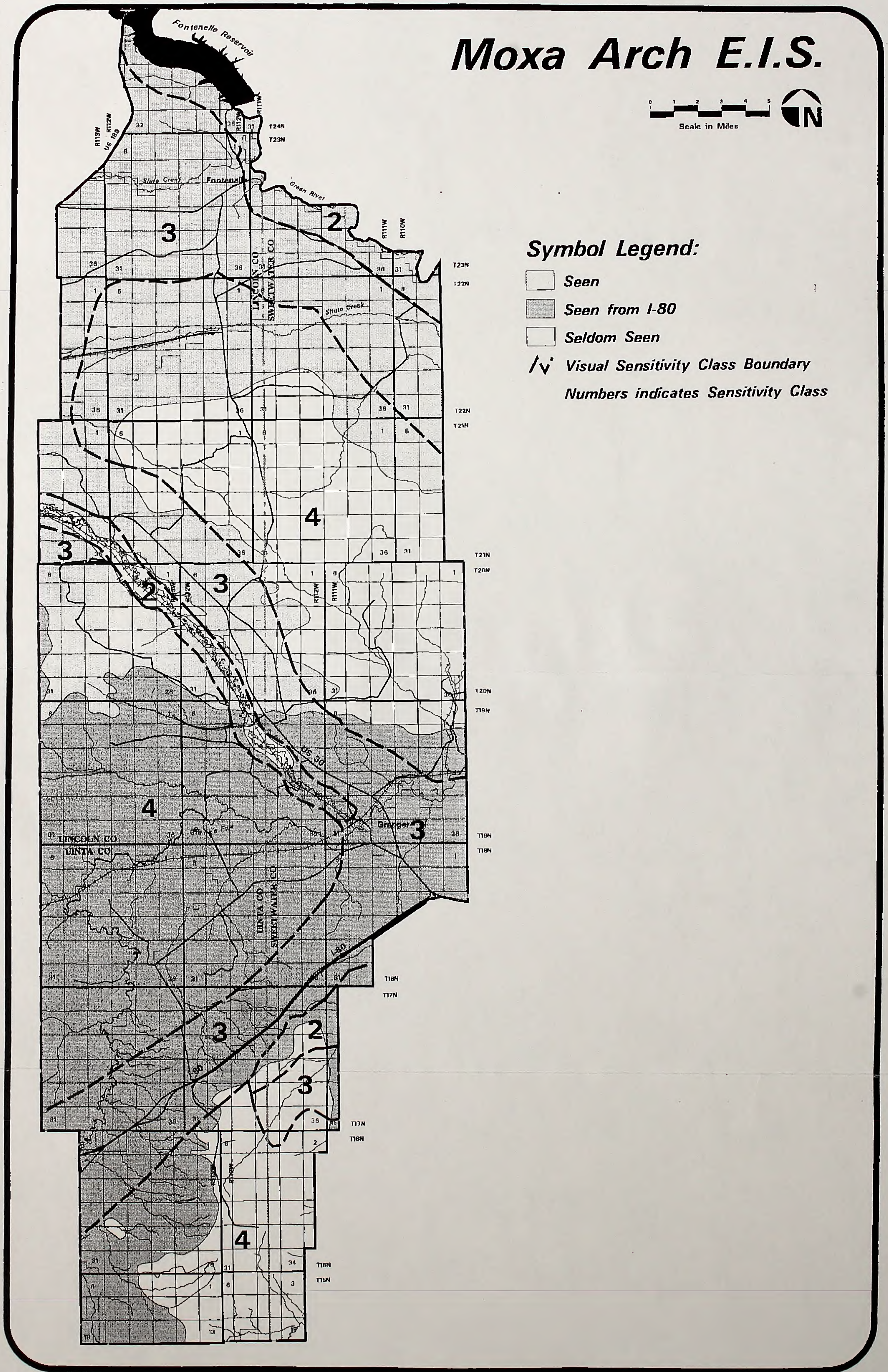

Exhibit 3-16. Visual Resource Management for the Moxa Analysis Area.

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River. However, the Moxa analysis area is adjacent to but does not include these features. There is some visual access from these recreation areas back into the Moxa analysis area. Fishing is a popular activity on both Fontenelle Reservoir and the Green River, and some fishing occurs along the Hams Fork during the summer.

Most backcountry recreation uses occur during the fall hunting season. The area provides excellent pronghorn hunting opportunities, which generally occur in September, and mule deer in the area are hunted in October. The high density of roads providing access to hunting appears to attract a disproportionately high number of elderly hunters (Mierzejewski 1994). The area also attracts small game hunters, particularly during the September and October sage grouse season. The existing oil and gas development activities in the Moxa analysis area may already conflict with some hunting activities. In some cases, the network of roads have made a relatively large tract of land more accessible for hunting.

Specific data on recreation visitation in the analysis area are unavailable. Overall recreation use levels are generally low to moderate because of limited numbers of local residents, a current reduction in pronghorn permits due to presently low population levels, and the presence of more attractive recreation alternatives in the region. Hunter numbers could increase in the future if antelope populations increase. Other than fall hunting activity, the area attracts limited numbers of recreationists engaged in backcountry camping, hiking, wildlife observation, off-road vehicle use, outdoor photography, picnicking, and scenic touring (USDI-BLM 1979). Although the analysis area itself receives limited recreation use, it is the gateway to Fontenelle Reservoir, Seedskadee National Wildlife Refuge, and the Green River, all regionally significant recreation resources. Portions of the analysis area are visible from all three of these recreation areas. Natural qualities, aesthetic factors and solitude/privacy are generally of high to moderate importance to those recreating in the analysis area (USDI-BLM 1979).

3.14 SOCIOECONOMICS

The analysis area for socioeconomic effects includes southern Lincoln County, western Sweetwater County and eastern Uinta County, Wyoming. The description of the affected socioeconomic environment focuses primarily on describing the area economy and certain aspects of the existing regional oil and gas industry. Area population, housing and community fiscal conditions are also generally described.

3.14.1 Local Economy

Mining, oil and gas production, agriculture, tourism and trade make up the economic base of the analysis area. The three counties rely on the mining sector (mineral mining plus oil and gas production) for at least 20 percent of total wages paid (Wyoming Department of Employment 1994). Recent (1992) full- and part-time employment and personal income by major industry for Lincoln, Sweetwater and Uinta counties are presented in Table 3-22.

3.14.2 Oil and Gas Industry

The relative economic importance of the oil and gas industry varies considerably among the three counties. The economy of Lincoln County is least dependent on oil and gas production with only about four percent of 1992 employment and 5.5 percent of total payroll associated directly with this sector. Uinta County is most reliant on the oil and gas industry (about 12 percent of 1992 employment and 22 percent of total payroll). In Sweetwater County, the oil and gas industry provided about five percent of employment and seven percent of total payroll in 1992 (Wyoming Department of Employment 1993). Additionally, because the oil and gas industry is a basic industry which brings money from outside the area into the local economy, it generates additional indirect jobs and income within the area.

Exhibit 3-17 displays recent oil and gas service employment in the area. The oil and gas service industry is well developed in southwest Wyoming and the many oil and gas fields located in the three-county area provide a base of work for the service companies located in these areas. Oil and gas service employment declined in the last half of the 1980s in response to declining oil and gas prices. During the last several years, service employment has begun to increase and new firms have located within the analysis area (Wyoming Department of Employment 1994).

Table 3-22. 1992 Full- and Part-Time Employment and Personal Income ($000) by County.

Employment Sector	Lincoln		Sweetwater		Uinta	
	# Employed	Income	# Employed	Income	# Employed	Income
Agriculture	73	$639	76	$34	100	$674
Mining	638	28,238	5,423	287,202	1,025	39,809
Construction	607	16,888	1,670	45,685	703	18,133
Manufacturing	526	14,078	707	30,312	190	4,832
Trans & PU	560	23,526	1,962	79,265	571	18,997
Wholesale	81	1,813	659	18,148	158	4,436
Retail Trade	1,199	12,915	3,990	51,001	2,102	21,932
Fin. Ins. & RE	270	2,501	1,073	9,836	447	4,095
Services	1,172	11,461	4,079	63,835	2,292	36,093
Government	1,338	28,516	4,201	97,520	2,225	49,377
TOTALS	**6,464**	**140,575**	**23,777**	**682,838**	**9,813**	**198,378**

Source: Wyoming Division of Economic Analysis.

Natural gas and oil well drilling activity in the three counties fluctuated substantially over the past few years. As shown by Table 3-23 the total number of wells drilled in Lincoln, Sweetwater and Uinta counties in recent years varied from a 1990 low of 126 to a 1992 high of 327 (WOGCC 1994). The high level of drilling activity in 1992 occurred in anticipation of the December 1992 expiration of the Windfall Profits Tax Act.

Table 3-23 and Exhibit 3-18 display the estimated number of wells drilled in Moxa from 1990 through 1993. The relative 1992 increase in drilling in Moxa was not as substantial as the increase in the three counties as a whole.

3.14.3 Population

Population levels in Lincoln, Sweetwater and Uinta counties remain below the peak levels of the mid-1980s. However, population levels in these counties have been growing in recent years and, as shown by Table 3-24 and Exhibit 3-19, are expected to continue to grow into the next century. Much of the analysis area population growth since 1990 can be attributed to expanding employment in the mining sector, including trona mining and soda ash manufacturing-related growth in Sweetwater County and eastern Uinta County and oil and gas activity throughout the analysis area.

Communities located in and adjacent to the analysis area include Rock Springs, Green River, Granger, Lyman, Mountain View, Evanston, Kemmerer, Diamondville, Opal and LaBarge. The population of most of these communities remains below peak levels from the 1980s.

Table 3-23. Number of Wells Drilled by County and in the Moxa Analysis Area (1990 through 1993).

County	1990	1991	1992	1993
Lincoln	28	65	119	60
Sweetwater	85	81	152	81
Uinta	13	23	56	81
TOTAL for the Counties	126	169	327	169
TOTAL in Moxa	N/A	149	175	125

Source: WOGCC 1994.

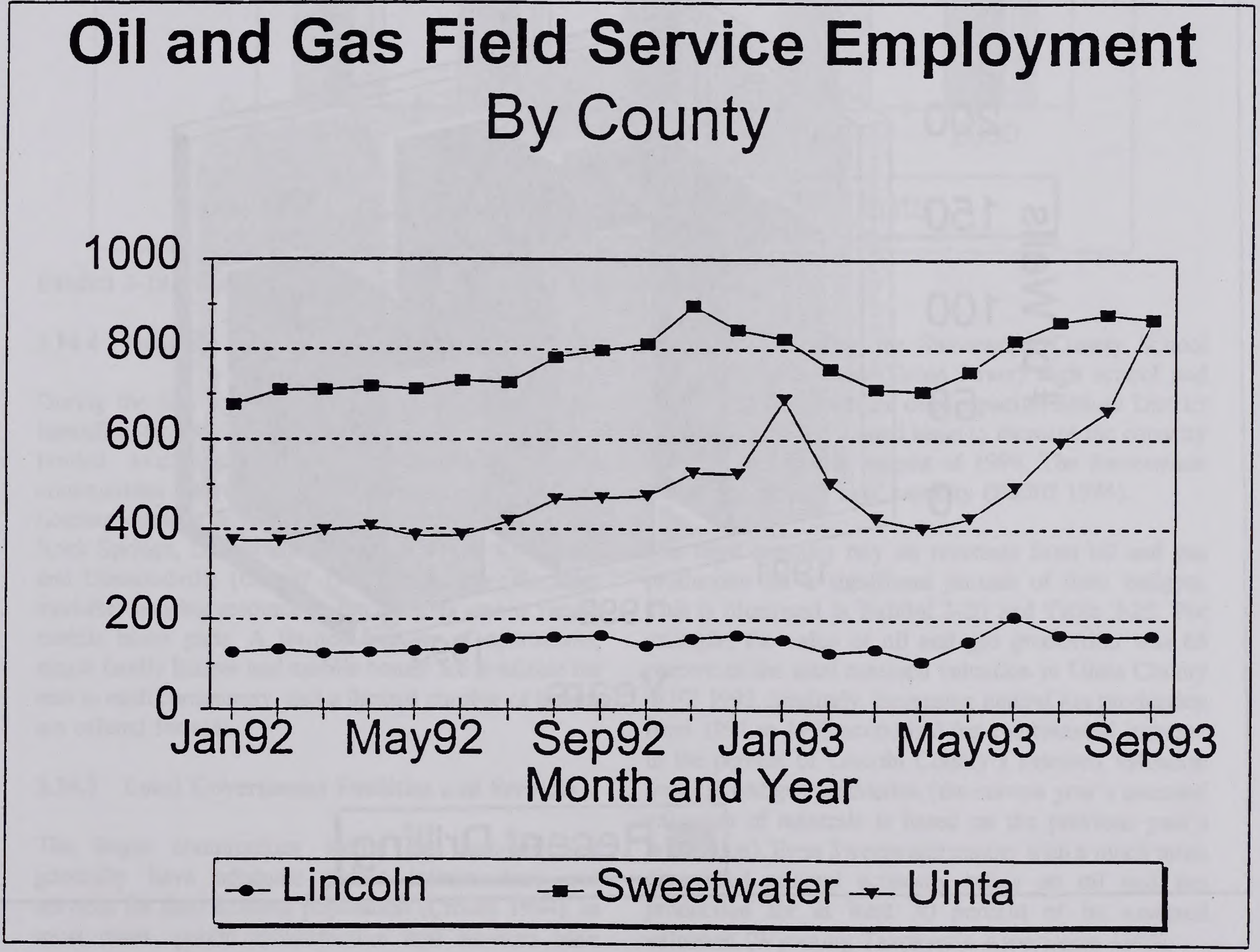

Exhibit 3-17. Oil and Gas Service Employment in the Moxa Analysis Area.

Table 3-24. County Population Estimates and Projections.

County	1980	1985	1990	1995	2000
Lincoln	12,177	14,319	12,625	13,330	13,600
Sweetwater	41,723	42,773	38,823	42,000	43,440
Uinta	13,021	22,351	18,705	20,500	21,280

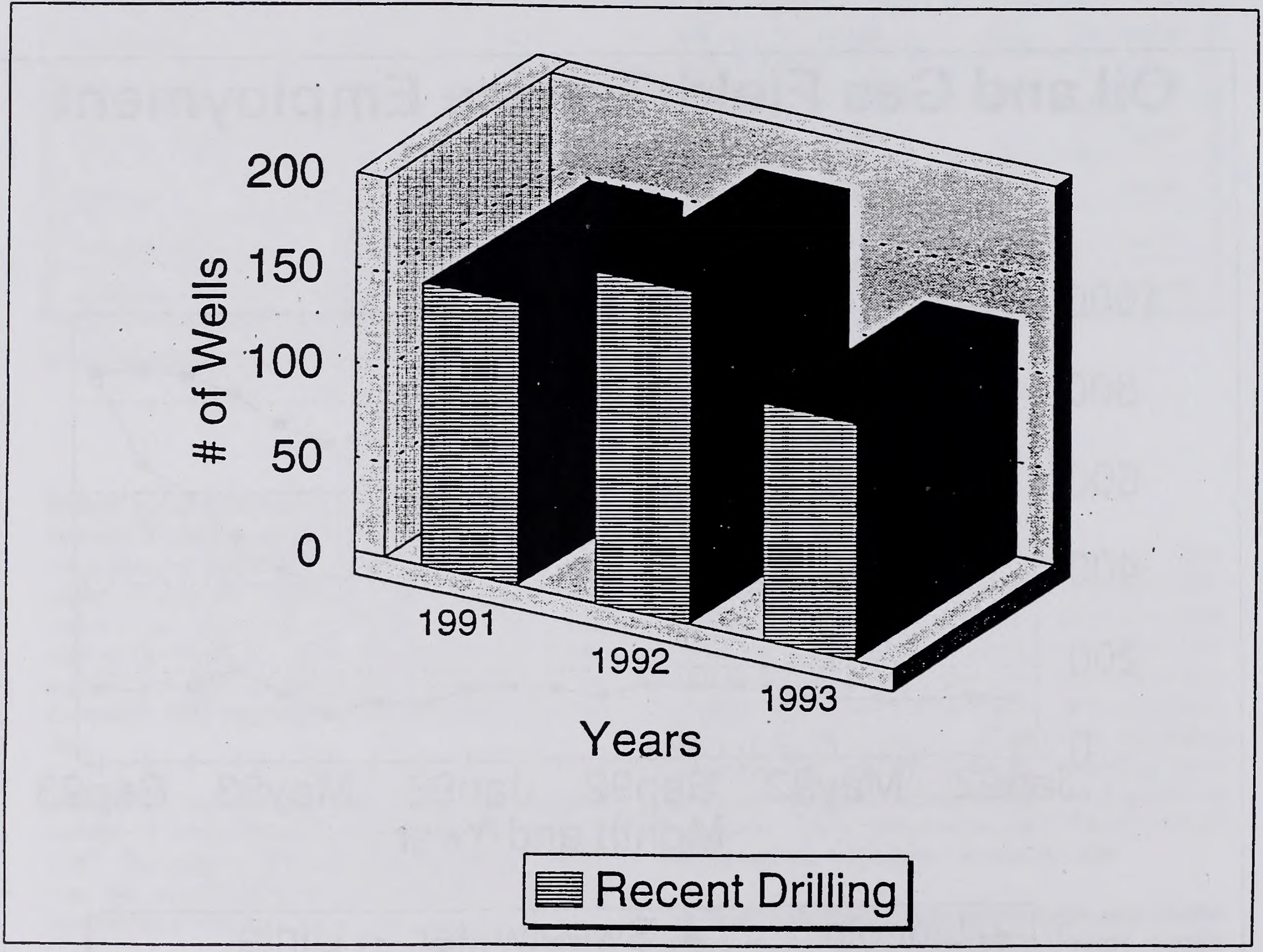

Exhibit 3-18. Estimated Number of Wells Drilled in Moxa from 1991 through 1993.

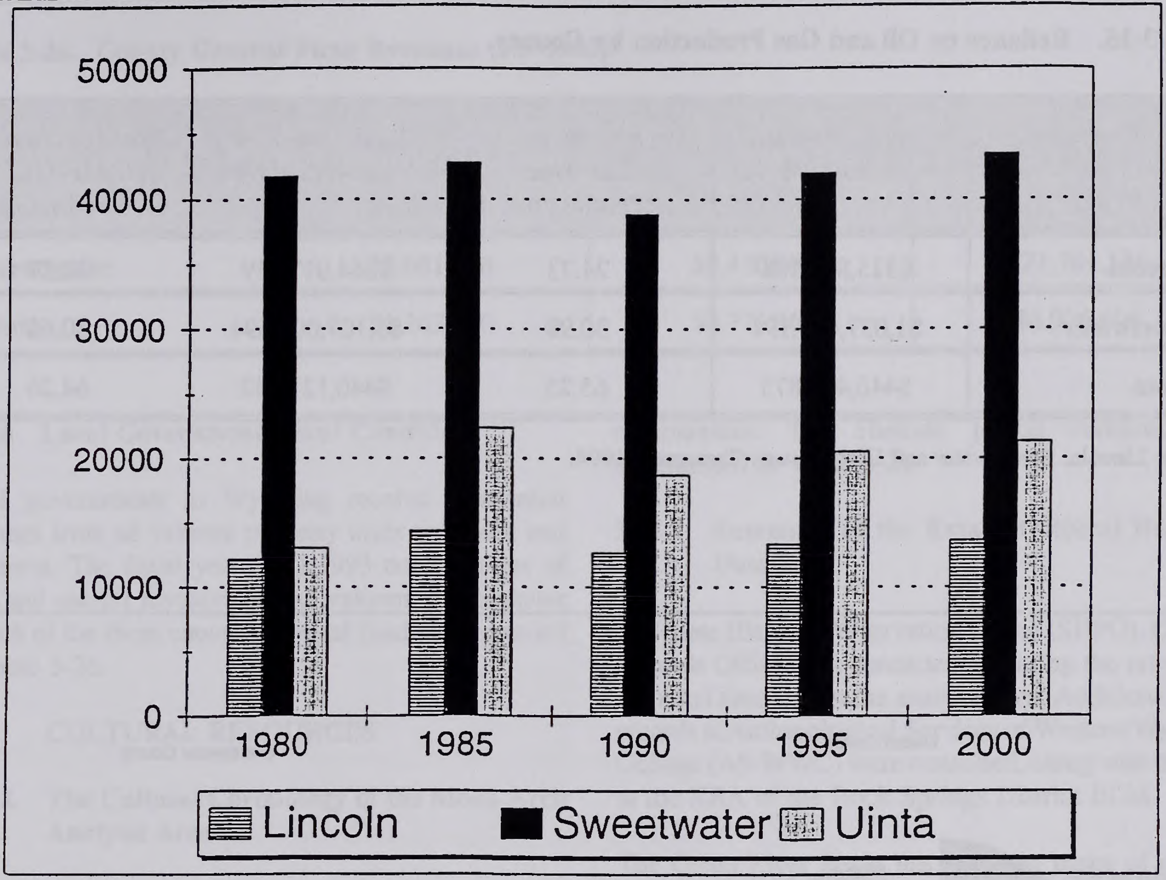

Exhibit 3-19. County Population Estimates and Projections.

3.14.4 Housing

During the EIS scoping process, one area of concern identified by local government officials was the very limited availability of housing in most of the communities surrounding the analysis area. Tight housing markets have been identified in Green River, Rock Springs, Lyman and Mountain View, Kemmerer and Diamondville (Crosby 1994). Currently, the most available housing resource in the analysis area is vacant mobile home pads. A limited number of apartments, single family houses and mobile homes are available for rent in each community, and a limited number of homes are offered for sale.

3.14.5 Local Government Facilities and Services

The larger communities within the analysis area generally have adequate public infrastructure and services for their existing population (Crosby 1994). In most cases, public infrastructure and services have excess capacity and could accommodate some population increases. There are certain notable exceptions, including the Sweetwater County School District Number Two (Green River) high school and middle school, which are over capacity. School District residents approved a bond issue to increase the capacity of these facilities in August of 1994. The Sweetwater County jail is also over capacity (Bailiff 1994).

The three counties rely on revenues from oil and gas production for a significant portion of their budgets. This is illustrated in Exhibit 3-20 and Table 3-25. For example, the value of oil and gas production was 65 percent of the total assessed valuation in Uinta County in FY 1992. Similarly, increasing natural gas production from 1991 to 1992 accounted for a substantial increase in the percent of Lincoln County's assessed valuation from oil and gas production (the current year's assessed valuation of minerals is based on the previous year's production). Even Sweetwater county with a much more diversified mineral economy relies on oil and gas production for at least 30 percent of its assessed valuation (Wyoming Taxpayer's Association 1993).

Table 3-25. Reliance on Oil and Gas Production by County.

County	Total Assessed Valuation FY 92	Percent from Oil and Gas Production	Total Assessed Valuation FY 93	Percent from Oil and Gas Production
Lincoln	$315,827,108	24.73	$364,017,419	32.27
Sweetwater	$1,037,428,194	30.98	$1,107,003,694	30.68
Uinta	$446,484,873	65.25	$440,121,742	64.26

Source: Lincoln, Sweetwater and Uinta County Treasurers 1994.

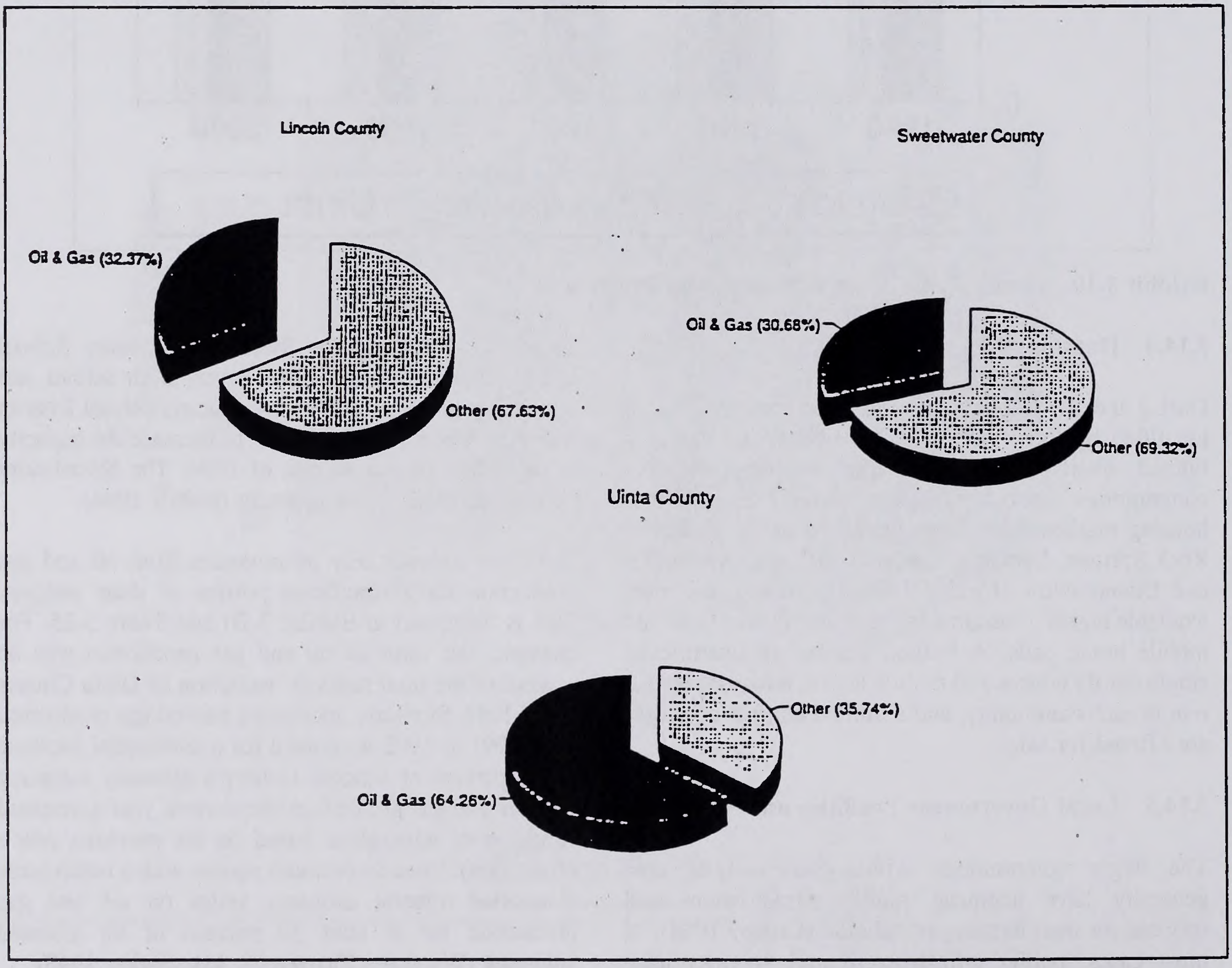

Exhibit 3-20. Oil and Gas Production as a Percentage of Total Assessed Valuation.

Table 3-26. County General Fund Revenues (FY 1993).

County	Sales and Use	Ad Valorem	TOTAL
Lincoln	$1,265,070	$2,937,985	$8,280,857
Sweetwater	$2,061,766	$8,450,966	$21,761,536
Uinta	$1,262,700	$4,771,360	$8,926,606

3.14.6 Local Government Fiscal Conditions

Local governments in Wyoming receive substantial revenues from ad valorem property taxes and sales and use taxes. The fiscal year (FY) 1993 contributions of sales and use tax revenues and ad valorem tax revenues to each of the three county's general fund are presented in Table 3-26.

3.15 CULTURAL RESOURCES

3.15.1 The Cultural Chronology of the Moxa Arch Analysis Area

Archaeological investigations in the Green River Basin indicate that the area has been used by prehistoric groups for at least 10,000 years, from PaleoIndian times until the present. The prehistoric cultural chronology applied to the Green River Basin is based upon the model devised for the larger Wyoming Basin by Metcalf (1987). The Wyoming Basin prehistoric cultural chronology is a revision of the chronology developed by Frison (1978) for the Northwest Plains. This revision was necessary because the archaeological record in the Green River Basin experienced differential influences periodically from the Great Basin, the Great Plains and the Colorado Plateau cultural areas. The Wyoming Basin prehistoric cultural chronology is summarized in Table 3-27.

The first historic use of the area was associated with trapping and explorers, followed by westward-bound emigrants. Homesteading supported initial settlement of the region. A system for distribution of goods and supplies was essential to the settlement of the region and the completion of the Union Pacific mainline in 1868 greatly facilitated transport of supplies. A road system was established to haul freight by wagon from the railhead to the surrounding ranches and small communities. The Historic period chronology is summarized in Table 3-28.

3.15.2 Summary of the Extant Cultural Resource Database

The State Historic Preservation Office (SHPO), Cultural Records Office, was contacted regarding the previously recorded sites within the analysis area. Additionally, the records at Archaeological Services of Western Wyoming College (AS-WWC) were consulted, along with the files at the KRA of the Rock Springs District BLM.

The Green River Basin has been the scene of cultural resource investigations since the 1940s. However, intensive investigations began in the 1970s pursuant to Section 106 of the National Historic Preservation Act (NRHP). Literally thousands of inventories, construction monitors, trench inspections, salvage, and small testing projects have been conducted in southwest Wyoming. A large number of these projects were located within the Moxa analysis area.

The occupation of the Green River Basin interior is well documented. Currently there are 2,994 cultural properties recorded within the analysis area: 2,756 are aboriginal sites, 124 are historic sites, and 114 are multi-component sites. The multi-component sites consist of two separate occupations: the earlier prehistoric aboriginal occupation overlain by a historic occupation. Thus, 2,871 prehistoric sites/components and 237 historic sites/components are present in the analysis area. The sites have been grouped into types based on postulated functional information from the site present in the analysis area. Table 3-29 contains a summary of the site types

Prehistoric site density is high in the Moxa analysis area with the greatest density expected near permanent water.

Table 3-27. Summary of Prehistoric Cultural Chronology of the Moxa Arch Analysis Area.

Period or Phase	Date
PaleoIndian Period	ca. 12,000 to 7,500 years B.P.
Early Archaic Period Great Divide Phase Green River Phase	ca. 8,000 to 4,500 years B.P. ca. 7,200 to 5,800 years B.P. ca. 5,800 to 4,200 years B.P.
Late Archaic Period Pine Spring Phase Deadman Wash Phase	ca. 3,000 to 1,500 years B.P. ca. 4,200 to 3,000 years B.P. ca. 3,000 to 1,800 years B.P.
Late Archaic/Late Prehistoric Transition Period	ca. 1,800 to 1,600 years B.P.
Late Prehistoric Period Uinta Phase Firehole	ca. 1,800 to 250 years B.P. ca. 1,800 to 1,000 years B.P. ca. 1,000 to 300 years B.P.
Protohistoric Period	ca. 450 to 150 years B.P.

Table 3-28. Summary of the Historical Chronology of the Moxa Arch Analysis Area.

Historic Period	Date
Traders and Trappers	1825 to 1840
Westward-bound Emigrants	1843 to 1868
Early Railroad	beginning in 1864
Euro-American Settlement	beginning in 1864

Other topographic features associated with higher site densities are sand dunes or dune complexes and local prominences which provide a vantage point.

3.15.2.1 Prehistoric Site Types

Lithic Scatter (n=601, 20.9 percent). Lithic scatters are defined by the presence of chipped stone debitage and/or chipped stone tools. The sites contain no features or evidence of features (fire-cracked rock). In terms of cultural behavior, these sites represent short duration activities, although the site may have been used more than once. The sites are primarily associated with the production of stone tools.

Open Camp (n=1913, 66.6 percent). Open camp sites contain evidence of a broader range of activities including residential locations associated with the collection, processing, and consumption of food resources. The site may contain lithic debitage, chipped stone tools, ground stone tools, and pottery.

Quarry (n=301, 10.5 percent). Sites defined as quarries are locations where unmodified raw toolstone was

Table 3-29. Summary of Prehistoric and Historic Sites Located in the Moxa Analysis Area.

Site Type	Total Number of Site Types
Prehistoric Sites	
Lithic scatter	600
Open camp	1,913
Quarry	301
Features only	55
Rock art	1
Unassigned type	1
TOTAL	2,871
Historic Sites	
Stockherding	69
Ranching and homesteading	38
Railroading	31
Historic trail/highway	15
Tourism	2
Cemetery	1
Unassigned type	80
Urban	1
TOTAL	237

collected and initially processed. In the Moxa analysis area this includes both primary and secondary deposits of suitable material. The Green River and Bridger formations contain numerous chert-bearing members that were exploited by the aboriginal populations. In some geologic settings, chert and quartzite specimens have been secondarily redeposited as lag cobbles.

Features Only (n=55, 1.9 percent). Sites that are grouped into this category consist solely of features and lack any other associated portable cultural material.

Other (n=1, 0.03 percent). One site could not be placed within one of the categories described above.

Rock Art (n=1, 0.03 percent). Rock art sites are rare in the analysis area. These sites consist of either painted (pictographs) or pecked/incised designs. The designs consist of both geometric or anthropomorphic motifs. These sites are thought to represent religious or ceremonial locales. There is a single rock art site in the analysis area.

3.15.2.2 Historic Site Types

Stockherding (n=69, 29.0 percent). These sites contain refuse left behind as a result of short duration episodes of stocktending. These sites are commonly referred to as sheepherder camps. Stockherding sites are primarily found in areas that support a vista or vantage point, are near stock bedding areas, and are near a water source.

Ranching and Homesteading (n=38, 16.0 percent). Sites that are considered as historic occupation sites consist of EuroAmerican homesteads. These can occur at any location, taking into account the necessity for water. Irrigation systems fall within this category.

Historic Trail/Highway (n=15, 6.3 percent). This category includes historic trails and wagon roads, highways, and sites associated with early EuroAmerican exploration of the area. A single early Euroamerican site associated with the mapping and initial documentation of the area by the federal government is present. The historic trails identified in the Moxa analysis area include the Oregon Trail, Overland Trail, Slate Creek Cutoff, Hams Fork Cutoff, and the Blacks Fork Cutoff (Exhibit 3-21).

Pony Express trails are also present within the area. Emigrant graves, debris scatters, stage stations, and pristine ruts are found along the trails. Local topographic features such as Church Butte were popular camping places along the Oregon Trail. The old Lincoln Highway (U.S. 30) is recorded in the area. One cemetery is recorded in the analysis area; the Whitney Cemetery is located along the Green River below the Fontenelle Dam and is possibly a homesteaders cemetery that had its antecedence in the Overland Immigration. While further research is needed to determine this, this cemetery may have been an immigrant cemetery initially.

Railroad (n=31, 13.0 percent). The 1868 Union Pacific railroad mainline traverses the analysis area. There are also a number of Union Pacific section camps (Verne, Church Buttes, Granger) associated with the mainline. The 1880s Oregon Shortline and associated section camps (Nutria, Moxa, Donovan, Hassett) are within the analysis area. In addition, it appears tie drivers may have used Fontenelle Creek to float rail ties to the Green River.

Unassigned (n=80, 33.6 percent). Sites that could not be assigned to a defined category were placed in this inclusive category.

Urban/Tourism (n=3, 0/03 percent). This category includes abandoned and occupied town sites and associated municipal areas such as cemeteries. The original location of Little America is within the analysis area.

3.15.3 Excavation Data

Within the Moxa analysis area, 23 sites have been the scene of large-scale testing and/or data recovery programs. Some sites were investigated several times during the course of multiple projects. These detailed investigations have generated large amounts of data concerning the prehistoric occupation of the analysis area. The information generated by the sites investigations has added greatly to our understanding of the prehistory of the analysis area.

Yearly movement of hunter/gatherer groups occupying the Wyoming Basin was driven by environmental constraints. Winter camps were located along the basin margins in areas of topographic relief which offered natural protection from the elements. Proximity to permanent water and fuel was a critical variable in selection of a winter camp. Additionally, the presence of sand deposits would facilitate construction of the semi-subterranean winter dwellings. Group size for winter camps is thought to consist of several extended families. With the onset of spring, the groups fragmented and moved into the lower elevation basin interior where newly emerging and greening plants were targeted. The patchy nature of resources in the Green River Basin required regular moves to exploit new sources.

As summer progressed, groups moved to the flanks of the basin to focus on later ripening plant species and herd animals which migrate to higher elevations. Late summer-fall occupations were centered in the basin interior to allow access to herds of animals congregating prior to winter. Additionally, plant resources were processed for winter stores.

The interior of the Green River Basin was primarily used by prehistoric hunter-gatherers during two periods: the late spring/early summer and fall. The patchy food resources in this environmental setting would support only small groups of people. In order to fully exploit the

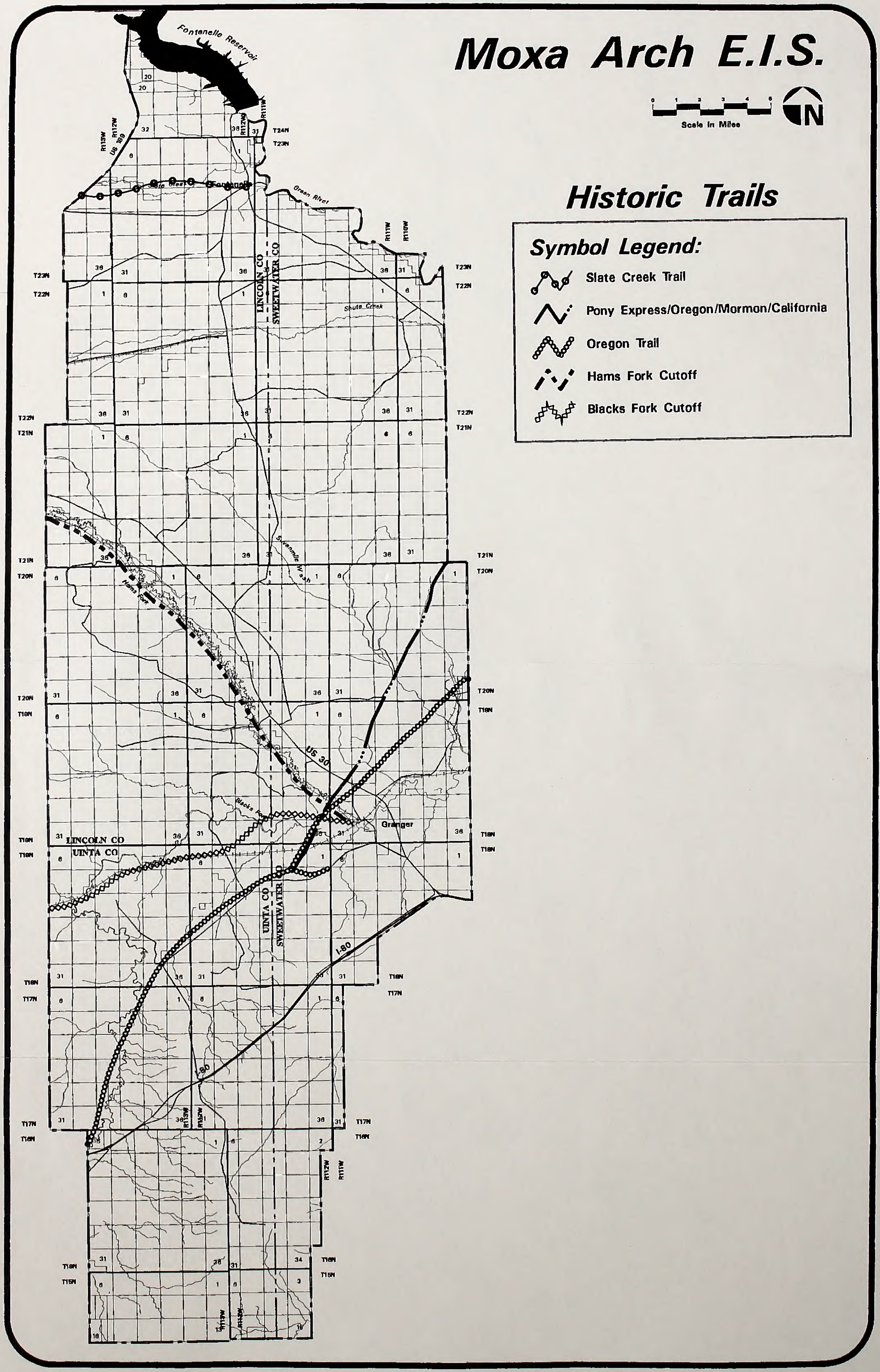

Exhibit 3-21. Historic Trails within the Moxa Analysis Area.

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economic resources, the inhabitants needed to be very mobile and knowledgeable about the land. This subsistence pattern generated thousands of sites within the analysis area. Most of these sites were reoccupied numerous times through the millennia. Buried stratified sites typically are encountered in eolian deposits, but low-energy colluvial and alluvial deposits can contain cultural material in an undisturbed context. Table E-1, Appendix E, lists the data recovery sites in the analysis area and some of the information acquired during the research.

3.16 HEALTH AND SAFETY

Health and safety concerns for the affected environment include the risk associated with vehicular travel on paved, graveled, and unimproved roads and risks associated with low probability events such as floods, landslides, and earthquakes. The hazards associated with drilling as well as encountering hydrogen sulfide (H_2S) gas are discussed in Environmental Consequences, Chapter 4.

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CHAPTER 4

ENVIRONMENTAL CONSEQUENCES

CHAPTER 4

ANALYSIS OF ENVIRONMENTAL CONSEQUENCES

4.0 INTRODUCTION

This chapter of the environmental impact statement (EIS) provides an analysis of the potential environmental consequences that would result from implementation of the proposed Expanded Moxa Arch Natural Gas Development project (Moxa) and/or alternatives, including the project components (access roads, drill sites, well drilling, completion and production operations, and reclamation). Certain measures that would avoid or reduce impacts under the Proposed Action have been included in Chapter 2. Additional information concerning reclamation guidelines is contained in Appendix B. The following impact assessment takes these measures into consideration. Additional opportunities to mitigate impacts beyond the measures proposed in Chapter 2 are presented in this chapter under Mitigation Summary for each resource discipline.

As noted in previous sections of this document, an environmental impact or consequence is defined as a modification or change in the existing environment brought about by the proposed action. Impacts can be direct or indirect in nature, and can be permanent (long-term) or temporary (short-term). Impacts can vary in degree ranging from only a slight discernable change to a drastic change in the environment. Short-term impacts are impacts that occur during and immediately after well pad construction, drilling, testing, and production and last from two to five years. For purposes of this EIS, short-term impacts are defined as lasting five years or less. Long-term impacts are impacts imposed by construction and operations that remain longer than five years and extend for the life of the project and beyond.

The description of the environmental consequences for each resource section in this chapter includes the following subsections:

Introduction - A description of the type and range of potential impacts that could occur as a result of implementation of the alternatives.

Resource Management Objectives and Impact Significance Criteria - A narrative of management objectives for the resource area and the threshold or magnitude at which an impact would be considered significant, thus warranting special attention such as special mitigation. These criteria are based on government regulatory standards, available scientific documentation, previously prepared environmental documents, and the professional judgement of resource specialists.

Direct and Indirect Impacts - An area-specific and site-specific impact assessment relative to the natural gas production alternatives. This section indicates which impacts are significant relative to the impact significance criteria.

Impacts Summary - A narrative comparison of direct and indirect impacts that would occur under each alternative and between alternatives.

Cumulative Impacts - A description of impacts likely to occur due to this project in combination with other on-going and recently approved activities, recently constructed projects and other past projects, and projects likely to be implemented in the near future (reasonably foreseeable future actions or RFFAs).

Mitigation Summary - A summary of additional measures that could be applied to avoid or reduce impacts. Mitigation items specified in the Mitigation Summary are *assumed to be* applicable to impacts on all lands, regardless of ownership. However, the Moxa Operators will coordinate with State and private land managers to determine which measures would be applied, to what degree, and where. The measures identified under this section would be considered for application to all Bureau of Land Management- (BLM) and Bureau of Reclamation- (BOR) administered lands.

Residual Impacts - A summary of significant impacts that are unavoidable and cannot be reduced or eliminated through the application of available and reasonable mitigation and, therefore, would remain throughout the duration of the project and to some point beyond.

The following impact assessment assumes all applicable standards, procedures, and mitigation measures would be applied over all lands. As indicated previously, the Moxa analysis area is comprised of a "checkerboard" of federal, State, and private lands. Mitigation cannot be required by the BLM on State and private lands. The land owner/manager will specify such measures. The degree of implementation of these measures on non-federal lands cannot be predicted or evaluated at this level of analysis. The set of final measures applied to non-federal lands would be determined during the application for permit to drill (APD) process. Not implementing the additional mitigation measures on these lands could result in increased severity and magnitude of impacts beyond those assessed in this chapter. Some discussion is provided in regard to differential application of mitigation and resultant impacts under each resource discipline section.

4.1 RANGE RESOURCES AND OTHER LAND USES

4.1.1 Introduction

Livestock grazing would continue within the Moxa analysis area during all phases of the natural gas development project. There would be some reduction in forage availability in those areas having natural gas development activities (e.g., well pad, access road, and pipeline construction). See Table 3-1 for percentage of animal unit months (AUMs) potentially lost by allotment as a result of development. No actions are currently envisioned within the Seedskadee National Wildlife Refuge (NWR).

4.1.2 Resource Management Objectives and Impact Significance Criteria

4.1.2.1 Resource Management Objectives

Management objectives provided in the Kemmerer Resource Area (KRA) Resource Management Plan (RMP) that pertain to the Expanded Moxa Arch Natural Gas Development proposal are as follows:

- Forage will be produced for livestock grazing and, at the same time, other resource values will be protected or enhanced.
- All noxious weed control will adhere to measures allowed in the Decision Record for the Rock Springs District Noxious Weed Control EA [environmental assessment] or applicable updated guidance. Cooperation with county weed and pest control programs will continue.
- Forage increases will be allocated to meet allotment objectives for all competing resources. In addition to providing for stability and growth in the livestock industry, forage increases will be allocated to meet the Wyoming Game and Fish Department's [WGFD] wildlife population objectives, as well as all applicable watershed and soils objectives.

4.1.2.2 Impact Significance Criteria

Impacts to the range resource would be significant if the following occurred:

- Non-compliance with management objectives outlined in Section 4.1.2.1 of this EIS and the Kemmerer RMP (USDI-BLM 1986).
- If any livestock operator were to lose five percent or more of allocated AUMs.

4.1.3 Direct and Indirect Impacts

4.1.3.1 Proposed Action

As discussed in Chapter 2, each constructed drill site would remove approximately five acres from forage production with implementation of the Proposed Action. This loss, combined with new road and pipeline construction loss of 10.3 acres, would result in an estimated loss of 15.3 acres of forage production per well site during the initial stages of the project. Stocking rates are estimated to vary between eight and 23 acres per animal unit month (AUM) between the various allotments within the analysis area, with an average stocking rate of about 13 acres per AUM. Depending on the actual locations of the well sites with respect to forage productivity, lost forage would vary between 0.7 and 1.9 AUMs, with an average of 1.2 AUMs per well site. Under the Proposed Action, an average of 1,590 AUMs (1.2 AUMs x 1,325 wells) of forage would be lost during drilling, access road, and pipeline construction (short-term loss of forage). Following reclamation and re-establishment of suitable range forage, approximately 2.8 acres (0.2 AUMs) of forage production per well site would continue to be removed from livestock use (long-term loss of forage). This constitutes an approximate loss of 265 AUMs through the ten-year planning period, or approximately 26.5 AUMs per year (assuming that an average of 132 wells would be drilled each year through the ten-year planning period). This would be a reduction of less than one percent of the current livestock forage use in the Moxa analysis area.

In addition to partial reclamation of well sites and access roads and total reclamation of pipelines, as existing older production wells in the Moxa analysis area are abandoned and reclaimed, additional land would become available for forage production. Actual amounts of additional forage available for livestock use following reclamation would be contingent on the success/failure of revegetation efforts.

The Proposed Action (1,325 wells through the ten-year planning period) is of a magnitude to possibly create adverse affects on some livestock operators, depending on well site, access road, and pipeline placement. Possible impacts would include loss of forage and disruption of livestock management practices, primarily herding. Most of these impacts would be short-term, lasting only as long as construction activities were on-going. Once production operations are underway and reclamation measures completed, impacts to livestock operations would be minimal.

The increased activity associated with drilling and production has the potential for disrupting livestock operations, particularly during the construction phase of development. Opportunities for vehicle-livestock collisions would increase. Also, the opportunity for livestock theft would likely increase as roads provide additional access into the allotments. However, additional roads in the Moxa analysis area may allow livestock operators improved access into the area, thus potentially providing them with greater ease of livestock management operations such as herding, etc. The potential for problems would decrease once the wells were producing and the traffic volume was reduced. The additional roads would have some advantages in that they would make some areas more accessible by vehicle for the livestock operators. Also, drilling may result in the development of additional water wells which could be converted to livestock use. This would improve the ability of livestock to make efficient use of rangeland within the area, especially during dry years.

Construction activities could provide for introduction of undesirable and noxious weed species into the analysis area. These undesirable annuals often out-compete the more desirable species, rendering an area less productive as a source of forage for livestock and wildlife. The Operators would be required to monitor disturbance areas for weed invasion and plan and implement weed control plans.

Given the actions and measures proposed by Moxa Operators (Chapter 2) and stipulations contained in the Kemmerer RMP, no significant impacts would occur to the range resources under this alternative.

4.1.3.2 Alternative A

The forage production removed under Alternative A is approximately 948 AUMs in the short term (initial construction and production phases). Following reclamation, approximately 158 AUMs would be lost through the ten-year planning period, or about 15.8 AUMs per year (assuming that an average of 79 wells would be drilled each year). This represents a loss in stocking levels of less than 0.01 percent throughout the Moxa analysis area in the long term. Overall, this level of reduction should not affect the livestock use in the analysis area, unless the well sites are located predominately on a select few permittee allotments and/or are located on areas where forage production is greater than the average of the Moxa analysis area.

The potential for livestock theft, and loss from vehicular collision, and the potential for introduction of weed species also exists as discussed under the Proposed Action but to a lesser degree. Also, the potential for enhancing livestock operations (water developments, better access) also exists with this alternative.

4.1.3.3 Alternative B - No Action

The conditions described in the Affected Environment chapter would generally remain unchanged under Alternative B (No Action) although there would be development associated with buildout of currently authorized facilities (USDI-BLM 1991a) as well as unquantified additional development on State and private lands as authorized on a case-by-case basis by the Wyoming Oil and Gas Conservation Committee (WOGCC). Disturbances to range resources located in close proximity to roaded areas and existing production facilities would continue due to vehicular use.

4.1.4 Impacts Summary

Impacts to the range resource would involve loss of livestock forage, potential for livestock loss through theft or vehicular collision, and the introduction of weed species. However, with implementation of the mitigation measures proposed by the Moxa Operators (Chapter 2) and stipulations in the RMP, impacts to range resources can be avoided or reduced to acceptable levels determined by the BLM.

4.1.5 Cumulative Impacts

Existing land management and use activities that have impacted the Moxa analysis area to varying degrees include livestock grazing, road construction and use, and construction of other well sites and pipelines. The additional area of disturbance resulting from implementation of the Proposed Action, Alternative A, or Alternative B would not substantially add to the cumulative impacts already occurring in the area. Other vegetative and range resource disturbances are occurring on lands adjacent to, and in the vicinity of, the Moxa analysis area. Implementation of any alternative would add to the cumulative amount of disturbance to vegetation and range due to these projects. However, significant cumulative impacts are not anticipated.

4.1.6 Mitigation Summary

No additional mitigation beyond that incorporated into Chapter 2 and the RMP would be necessary. These measures may not be fully implemented on non-federal lands.

4.1.7 Residual Impacts

There would be no residual impacts to range resources or other land uses as a result of implementation of the Proposed Action or alternatives assuming the mitigation measures would be fully implemented on all lands. If the identified measures are not consistently applied, the resultant impacts to range resources would be of greater magnitude than identified in this EIS. Should any development actions be proposed on the Seedskadee NWR, such actions would need to be fully coordinated with the U.S. Fish and Wildlife Service (FWS) and a site-specific environmental analysis completed outside the scope of this EIS.

4.2 AIR QUALITY

4.2.1 Introduction

As is the accepted procedure in assessing air quality consequences, emphasis is placed on identifying maximum or "worst-case" impacts to air quality and to air quality-related values (AQRVs) such as visibility, acid deposition, and soils and vegetation. By examining the worst-case impacts, if it is found that all projected impacts would be less than applicable significance criteria require, then there is an assurance that normal and routine operation of Moxa proposed activities would not jeopardize these air quality standards and AQRVs.

The pollutant emissions from the Proposed Action and from the two alternatives would occur in two phases. For each individual well site, the first phase is a construction phase, during which the well site infrastructure is built and the wells are drilled, completed, and tested. The second phase is a production phase in which gas is extracted from the wells and routed to pipelines. Of the two phases, the first phase is by far the larger emitter of air pollutants due to its construction vehicle traffic, drilling rig emissions, and gas flaring. Therefore, air quality impacts from only the construction phase are examined in this chapter.

Individual well sites could be constructed concurrently. However, there is considerable separation between well sites. Consequently, there would not be significant overlap between air pollutant concentrations from one well site and nearby well sites. Cumulative impact would be limited to emissions from one well site plus any existing pollutant concentrations in the Moxa analysis area.

Under all alternatives except Alternative B (No Action), there would be four main emission- producing activities associated with each well site during the construction phase:

- Construction of the access road that connects the well site to the local road. This construction activity would take about five days for each well site.

- Construction of the well site pad, requiring about five days, and coinciding with construction of the access road.

- Transportation of the drill rig, drill pipe, and other equipment/supplies to the well site, coinciding with rig-up, drilling, and rig-down. This effort would require about 25 days for each well site, and would occur after access road and pad construction.

- Well completion and testing for about 25 days, during which time gas flaring could occur for a maximum of ten hours per day for ten days.

Moxa emission sources would have the potential to impact air quality in two distinct ways:

- Direct Emissions. Emissions of air pollutants into the atmosphere would have a cumulative effect by contributing to increased concentrations of those pollutants. Pollutant concentrations add directly to those concentrations that already occur in the vicinity. The total magnitude of these air pollutant concentrations must not exceed applicable ambient air quality standards.

- Secondary Effects. Atmospheric pollutant concentrations can have secondary effects that may prompt impairment to visibility, harm to plants and animals (flora and fauna), or deleterious effects on surface waters caused by acid deposition.

Both of these potential air quality impacts would be eliminated, or minimized to acceptable and legal levels (per Wyoming Department of Environmental Quality [WDEQ] guidelines).

4.2.2 Resource Management Objectives and Impact Significance Criteria

4.2.2.1 Resource Management Objectives

Management directives provided in the Kemmerer RMP that pertain to the Expanded Moxa Arch Natural Gas Development proposal are as follows:

- The KRA will be managed to protect and enhance air quality through careful planning and coordination with the State of Wyoming. Most specific stipulations will be deferred to the stage where air pollutant emissions permits are issued by the State of Wyoming.

- When sources of air pollutant emissions are proposed, stipulations related to the protection of air quality will be added to BLM authorizations. The BLM will coordinate with the Wyoming Department of Environmental Quality/Air Quality Division (AQD) during the issuance of permits to construct facilities which would be emission sources.

- The BLM will consider the potential impacts of the release of hazardous air contaminants. The accidental release of sour (H_2S-rich) gas will be given special attention. A contingency plan will be required for APDs in sour gas areas.

4.2.2.2 Impact Significance Criteria

The significance criteria for air quality include state and federally enforced legal requirements to ensure that ambient air pollutant concentrations remain below specified levels. These include the maximum ambient air concentrations shown in Table 4-1, and the Prevention of Significant Deterioration (PSD) increments that limit the amount of pollutant concentration increase that is allowed in certain areas, shown in Table 3-3.

4.2.3 Direct and Indirect Impacts

The air quality impacts from the Proposed Action are evaluated separately for three considerations: pollutant emission rates, ambient air pollutant concentrations, and AQRVs.

4.2.3.1 Pollutant Emission Rates

The total pollutant emission rates expected from the construction, rig-up, drilling, completion, testing, and flaring at one well site are shown in Table 4-2 (TRC 1994). Emission rates of all pollutants are smaller than Wyoming and federal threshold levels.

Some wells within the Moxa analysis area may require a compressor to pressurize the gas for effective withdrawal from the natural gas reservoir. Such compressors would operate on the methane generated at the well and would be minimally and intermittently used over time. An insignificant amount of combustion products would be released.

Table 4-1. Potential Pollutant Emission Rates from Each Well Site.

Pollutant	Emission Rate (tons per year)	Threshold Level
PM_{10}	6.25	15
VOCs	1.13	40
CO	2.34	100
NO_x	32.33	40
SO_2	1.79	40
lead	negligible	0.6
H_2S	negligible	10

Source: TRC 1994.

Table 4-2. Comparison of Modeled Concentrations with Wyoming Ambient Air Quality Standard ($\mu g/m^3$).

Pollutant	Modeled Concentration	Background Concentration	Total Concentration	Wyoming Standard
PM_{10}				
Annual	4.94	12	16.64	50
NO_x				
Annual	8.41	3	11.41	100
CO				
1-Hour	137.12	3,500	3,637.12	40,000
8-Hour	57.78	1,500	1,557.78	10,000
SO_2				
3-Hour	70.50	63	133.5	1,300
24-Hour	34.09	32	66.09	260
Annual	0.51	2	2.51	60

Source: TRC 1994.

Table 4-1 also indicates that lead will be emitted in negligibly small amounts. The lead emissions would be expected to be negligibly small because there is no reason to believe that there would be any lead content in the soil disturbed by construction activity. Similarly, because there is no hydrogen sulfide in the natural gas, there will be no H_2S emissions.

4.2.3.2 Ambient Air Concentrations

Because pollutant emission rates from the well sites are smaller than threshold levels, there is no requirement that the applicant demonstrate compliance with ambient air quality standards. Nevertheless, compliance with ambient air quality standards are checked in this section

Table 4-3. Visual Effects Screening Analysis Results.

Viewer Location	Background	Delta E		Contrast	
		Criteria	Plume	Criteria	Plume
Inside	Sky	2.00	0.191	0.05	-0.002
	Terrain	2.00	0.037	0.05	0.001
Outside	Sky	2.00	0.205	0.05	-0.002
	Terrain	2.00	0.130	0.05	0.002

Source: TRC 1994.

to ensure that no significance criteria are adversely impacted.

In Table 4-2 the maximum modeled ambient air concentrations that are expected to occur during construction of well sites and roads and during drilling operations, are compared with Wyoming Ambient Air Quality Standards (WAAQS) (TRC 1994). The modeled concentrations shown in Table 4-2 represent pollutant contributions from a single well site.

Wyoming also enforces a 24-hour total suspended particulate (TSP) ambient standard, but it is only applied to point sources whose TSP emission rates are well quantified. Because the TSP emissions from the well sites are from fugitive sources, no comparison is made with the TSP 24-hour standard in Table 4-2. Total modeled concentrations are added to background concentrations to yield total concentrations, shown in Table 4-2. All modeled concentrations are smaller than allowable by WAAQS.

4.2.3.3 Air Quality-related Values

An analysis of impairment to AQRVs includes assessment of the air pollution impact to visibility, surface waters (via acid deposition), and soils/vegetation.

Visibility. One form of visibility impact assessment examines whether an air pollutant "plume" from an emission source would be detectable or "visible" at the nearest Class I area (classes are defined in the glossary). The criteria for "visible" in this instance is based on the relative contrast between the plume/sky, and the plume/terrain. Computations of contrast are made using the Environmental Protection Agency's (EPA) VISCREEN I computer model (EPA 1994), which makes very conservative assumptions about the meteorological conditions that transport the plume to the Class I area and about the reflectivity and light absorption of the plume when viewed against the sky or nearby terrain. Results of the VISCREEN model are expressed in terms of extinction (Delta E) and Contrast. Table 4-3 shows that all measures of plume visibility at the nearest Class I area, the Bridger Wilderness, are smaller than allowable visibility criteria. This indicates that the plume from the Moxa Operators proposed well sites would not be visible from either inside the Wilderness (looking out towards the wells) or outside the Wilderness (looking in towards the Wilderness).

A second kind of visibility impairment is reduction in visual range, or how far away a person can see a distant object. Reductions in visual range are caused by small, particle-induced light scattering, and light scattering or absorption from small particles. The degree to which the visual range is reduced is determined by the Koschmieder equation, which computes the fractional decrease in visual range, combined with assumptions of "worst-case" particle density, mass median diameter, and distribution of particle sizes. Choosing values of these parameters that will maximize the reduction in visual range, and making assumptions about the prevailing meteorology (500 meter mixing height and one meter/sec wind speed), indicates that the reduction in visual range will be 0.005 percent (TRC 1994), much smaller than the commonly accepted limit of perceptible visual range reduction of five percent (EPA 1980).

Acid Deposition. Acid deposition (acid rain) is a complicated phenomenon in which primary gaseous pollutants are transformed into secondary pollutants (sulfates and nitrates) and are deposited on the ground and in bodies of water in the form of weak acids. Acid deposition can have deleterious effects on water quality and on aquatic life in the lakes. Certain lakes in the Bridger Wilderness have been identified as being potentially sensitive to acidic deposition, with measured alkalinities of less than 200 micro-equivalents per liter (µeq/l).

Sulfur dioxide (SO_2) and nitrogen dioxide (NO_2) emitted from the proposed Moxa well sites would transform into sulfates and nitrates, and then convert to weak acids. Acid deposition rate computations are based on equations recommended by Fox (1983), and yield annual average deposition as a function of 1) airborne concentration over the watersheds and 2) acid deposition velocity. Implicit in the computations are the assumptions that the plume transport trajectory from the applicant's proposed well sites to the target watersheds follows a straight line and is unimpeded by terrain; that all NO_2 is converted directly and completely to its strong acid form; that wet deposition is equal in magnitude to dry deposition; and that no depletion of the plume occurs prior to reaching the watershed, at which point all of the pollutant is immediately transformed. With these assumptions, acid fluxes are computed at three of the most sensitive lakes in the Bridger Wilderness. Annual average nitrogen and sulfur deposition (flux) calculated from the proposed Moxa well sites is shown in Table 4-4. The pH change and the acid neutralizing capacity (ANC) change that could occur as a result of these fluxes is also calculated and appears in Table 4-4 (TRC 1994).

The change in pH at all lakes and watersheds is less than the significant criteria of 0.1 pH, and the change in ANC is less than ten percent, indicating that no adverse acid deposition effects are expected as a result of the proposed well site construction and operation.

Soils and Vegetation. Impairment to soils and/or vegetation as a result of air pollutants is indicated first by vegetation damage. Consequently, if concentrations are sufficiently low to ensure that no vegetation damage will occur, then they are low enough to protect soils. Plants especially susceptible to NO_2 are summarized in Table 4-5 (EPA 1979).

To convert annual average concentrations to short-term one-hour concentrations, the long-term values can be multiplied by ten (EPA 1977). Because the maximum modeled annual average NO_2 concentration in the vicinity of the proposed well sites plant is expected to be 11.41 $\mu g/m^3$, the greatest short-term concentration would probably not exceed 114.1 $\mu g/m^3$. Because this short-term concentration is smaller than all of the vegetative criteria shown in Table 4-5, no vegetation damage would be expected as a result of construction and/or operation of the applicant's gas well sites.

4.2.3.4 Impacts of Alternatives

4.2.3.4.1 Proposed Action

Under the Proposed Action, Moxa Operators would be allowed to develop 1,325 well locations over the next ten-year planning period (1995-2005) in addition to existing drilling and production operations within the Moxa analysis area. The Proposed Action would not cause exceedances of the air quality significance criteria.

4.2.3.4.2 Alternative A

Under Alternative A, Moxa Operators would be allowed to develop 795 well locations over the next ten-year planning period in addition to existing drilling and production operations within the analysis area. As with the applicant's Proposed Action, Alternative A would not cause exceedances of the air quality significance criteria. Maximum, localized ground level air pollutant concentrations under Alternative A would not be appreciably different than those associated with the applicant's Proposed Action because each individual well site would still exhibit concentrations of the magnitude shown in Table 4-2.

4.2.3.4.3 Alternative B - No Action

Under Alternative B, the on-going natural gas production activities would be allowed to continue in the analysis area and previously authorized wells would be constructed. Additional wells may be authorized by the WOGCC for State and private lands, but the proposed field development as presented in this EIS would be disallowed. As with Alternative A, this alternative would not cause exceedances of significance criteria.

Table 4-4. Input Variables and Results of pH and ANC Change Computations.

Lake/Watershed	Existing ANC (μeq/l)	Nitrogen Flux (kg/ha-yr)	Sulfur Flux (kg/ha-yr)	Change in pH	Change in ANC (percent)
Klondike	20	0.0132	0.0033	0.00208	0.47686
Titcomb	34	0.0161	0.0036	0.00146	0.33572
Black Joe	70	0.0170	0.0040	0.00075	0.17364

Source: TRC 1994.

Table 4-5. Summary of NO_2 Plant Damage Exposure and Concentrations.

Plant	Concentration (μg/m³)	Exposure (days)
Tomato (*Lycopersicon esculentum*)	470	128
Naval Oranges	470	240
Endive (*Cichorium endiva*)	1,880	2
Cotton (*Gossypium hirsutum*)	1,880	2
Lichens	3,960	0.25

Source: EPA 1979.

4.2.4 Impacts Summary

The construction and operation of additional well sites as proposed by Moxa Operators, or as proposed under Alternatives A or B, would not have significant air quality impact. The airborne pollutant concentrations that would result from the increased well site emissions would meet all Wyoming and federal ambient air quality standards. Likewise, the impact to AQRVs (i.e., visibility, acid deposition, and soils/vegetation) would be below significance criteria levels.

4.2.5 Cumulative Impacts

The air quality impacts resulting from the Moxa Operators' Proposed Action or from Alternative A would contribute to the existing air quality impacts in the analysis area. Under the Proposed Action, the considerable separation of well sites would result in localized emissions and pollutant concentrations that decrease rapidly with distance from the emission sources. This indicates that areas of impact for these individual well sites would not overlap; therefore, cumulative impact can be represented by pollutant concentrations resulting from one well site plus any existing background concentration. The air quality impacts shown in Table 4-2 reflect the cumulative impact of the Proposed Action. These cumulative impacts fully comply with the allowable WAAQS.

Because well sites constructed under Alternatives A and B would be separated more than the Proposed Action on the flank and emissions and pollutant concentrations would be localized as they are for the Proposed Action, cumulative impact from these alternatives would be represented by air quality impacts from an individual well site. These air quality impacts from one well site are shown in Table 4-2.

4.2.6 Mitigation Summary

By incorporating air pollutant mitigation measures identified in Chapter 2 (Section 2.2.4.2.2) into the Proposed Action, no additional mitigation measures would be needed to address impacts to air quality. Because mitigation measures are pursuant to State and federal regulations, they would be applied equally to federal, State, and private lands.

4.2.7 Residual Impacts

Other than the impacts described and quantified in Section 4.2.3, there will be no other residual impacts.

4.3 TRANSPORTATION

4.3.1 Introduction

Transportation effects of the Proposed Action and alternatives would occur primarily on U.S. Interstate 80 (I-80), U.S. Highway 30 (U.S. 30), U.S. Highway 189 (U.S. 189), and Wyoming Secondary Highways 372 (WY 372) and 240 (WY 240). These highways provide access from nearby communities to the analysis area. Secondary transportation effects would also occur on county- and operator-maintained roads within the analysis area.

4.3.2 Resource Management Objectives and Impact Significance Criteria

4.3.2.1 Resource Management Objectives

Management objectives provided in the Kemmerer RMP (USDI-BLM 1986) that pertain to the Expanded Moxa Arch Natural Gas Development proposal are as follows:

- Recognized roads will be used when the alignment is acceptable for the proposed use. Generally, roads will be required to follow natural contours, be constructed in accordance with acceptable standards, and be reclaimed to BLM standards.
- On newly constructed roads and permanent roads, the placement of topsoil, seeding, and stabilization will be required on all cut and fill slopes (unless conditions such as rock prohibit this).
- Reclamation of abandoned roads will include requirements for reshaping, recontouring, resurfacing with topsoil, installation of water bars, and drill seeding on the contour. The removal of structures such as bridges, culverts, cattleguards, and signs will be required. Additional erosion control measures and road barriers to discourage travel may be required.

4.3.2.2 Impact Significance Criteria

The following criteria were used to determine whether transportation impacts of the Proposed Action and alternatives would be significant:

- Increases in traffic levels on the local public highway network that would cause the level of service on large segments of those public highways to fall below acceptable levels as defined by the responsible government agency.
- Measurable increases in accident rates on the local public highway network above the average accident rate for similar roadways which would increase the risk to highway users.

4.3.3 Direct and Indirect Impacts

4.3.3.1 Proposed Action

The Proposed Action would generate increases in traffic volumes on highways leading to the analysis area and on county- and operator-maintained roads within the Moxa analysis area. These increases would result from the movement of workers, equipment and materials to and from the analysis area to perform drilling, field development, well service, field operations and reclamation activities. Additionally, in order to perform the well field development activities associated with the Proposed Action, new access roads would be required. It is assumed that an average of 0.61 mile of access road would be developed for each well associated with the Proposed Action (USDI-BLM 1991a). This would result in a total of approximately 800 miles of new access roads associated with the Proposed Action.

Table 2-2 in Chapter 2 displays the estimated average number of trips associated with various well field development and operations activities. Table 4-6 and Exhibits 4-1 and 4-2 display estimated Proposed Action-related increases in average daily traffic (ADT) on highways within the analysis area. Trips identified in Table 2-2 were assigned to highways based on the approximate number of wells to which each highway will provide access.

Proposed Action-related increases in traffic volumes are anticipated to be insignificant relative to existing capacity on highways within the analysis area. (The estimated increases shown in the table are likely to be high because traffic related to drilling and field-development activities associated with the Proposed Action will replace similar types of traffic reported in the 1993 baseline traffic counts.) The only incremental increase in traffic would be that associated with the increased number of wells, well field facilities and roads. The greatest increases would occur on I-80 and U.S. 30. As shown in Exhibit 4-1 the estimated 428 increase in ADT on I-80 represents a relatively small percentage increase (about four percent). The estimated increase in ADT of 348 on U.S. 30 is higher (about 19 percent) but the increase is not expected to affect the level of service on U.S. 30. The portion of U.S. 30 which would experience the greatest use has been designed to withstand sustained high volumes of traffic. According to the Wyoming Department of Transportation (WYDOT), U.S. 30 could withstand almost a 100 percent increase in traffic before the level of service would deteriorate to Level D (Rounds 1994). Consequently, the estimated proposed action-related increases do not approach levels which would cause a decrease in the level of service on these highways.

Exhibit 4-2 portrays the Proposed Action-related increases in ADT on other area highways. As shown by the exhibit and preceding table, the Proposed Action-related increases in ADT range from 16 to 54, which represents four to six percent increases over 1993 ADT levels for these highways. These relatively small increases will not diminish current levels of service on highways within the analysis area.

It is unlikely that the relatively low increase in traffic volumes on highways within the analysis area would result in a measurable increase in accident rates, given that these highways currently accommodate substantial well field development and operations-related traffic. The Proposed Action-related increases are not anticipated to result in a decrease of level of service for these highways.

County- and operator-maintained roads internal to the analysis area currently service primarily well field development and operations-related traffic. Proposed Action-related activities would result in a substantial number of additional trips on internal roads. This additional volume of traffic is not anticipated to negatively affect levels of service or accident rates on internal roads. However, demand for road maintenance would increase substantially on certain heavily travelled internal roads. Proposed Action-related tax revenues would be available to off-set additional maintenance costs for county road and bridge departments. Additional road maintenance costs on operator-maintained roads would be absorbed as business costs.

Given that traffic increases associated with the Proposed Action are not anticipated to result in a decrease in the levels of service of any highway and that accident rates are not anticipated to increase, the transportation impacts of the Proposed Action would be below the significance threshold established for this analysis.

4.3.3.2 Alternative A

Implementation of the Minimum Development alternative would result in transportation impacts decreased by 60 percent of those described for the Proposed Action. Since this alternative would concentrate development in the proven area, fewer than 60 percent of the roads and pipelines planned for the Proposed Action would be developed. Increase in traffic associated with this alternative would not be significant under the thresholds established for this analysis.

4.3.3.3 Alternative B - No Action

Alternative B would result in transportation conditions similar to those described in Chapter 3 (Section 3.3.1) with the addition of traffic associated with construction and production of previously authorized APDs and traffic associated with unquantified additional well development on State and private lands as authorized by

Table 4-6. Proposed Action-Related Increases in Average Daily Traffic on Highways within the Moxa Analysis Area.

Highway Segment (mileposts)	1993 ADT All Vehicles Wtd. Avg./Peak	Estimated Increase in ADT/Percent Increase	1993 Accidents/Million Vehicle Miles Traveled	1993 Average Accident Rate (by Hwy Class)
I-80 (mp 6.26 - 107.06)	10,042/15,010	428/4 percent	1.16	1.15
U.S. 30 (mp 55.13 - 100.03)	1852/2070	348/19 percent	0.58	1.17
U.S. 189 (mp 0.0 - 66.86)	2998/5590	37/4 percent	0.58	1.17
WY 372 (mp .114 -48.59)	914/2,790	54/6 percent	0.71	1.65
WY 240 (mp 0.0 - 12.29)	304/400	16/5 percent	0.81	1.65

Source: Wyoming Department of Transportation (Wallace 1994), PIC.

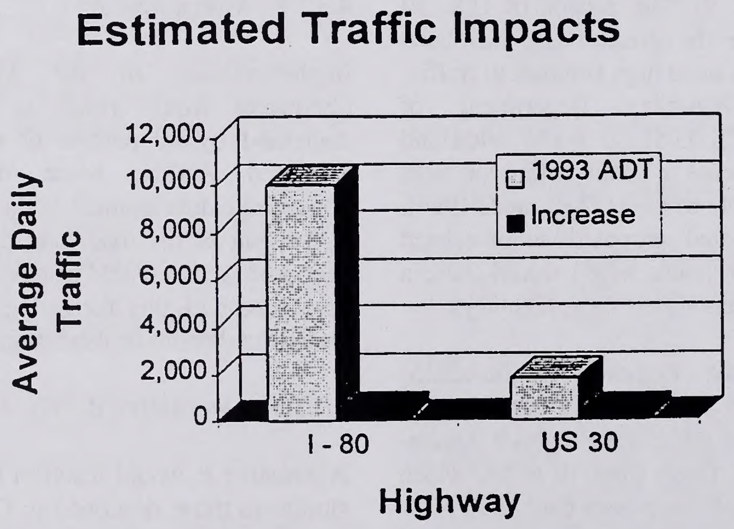

Exhibit 4-1. Estimated Traffic Impacts for I-80 and U.S. 30.

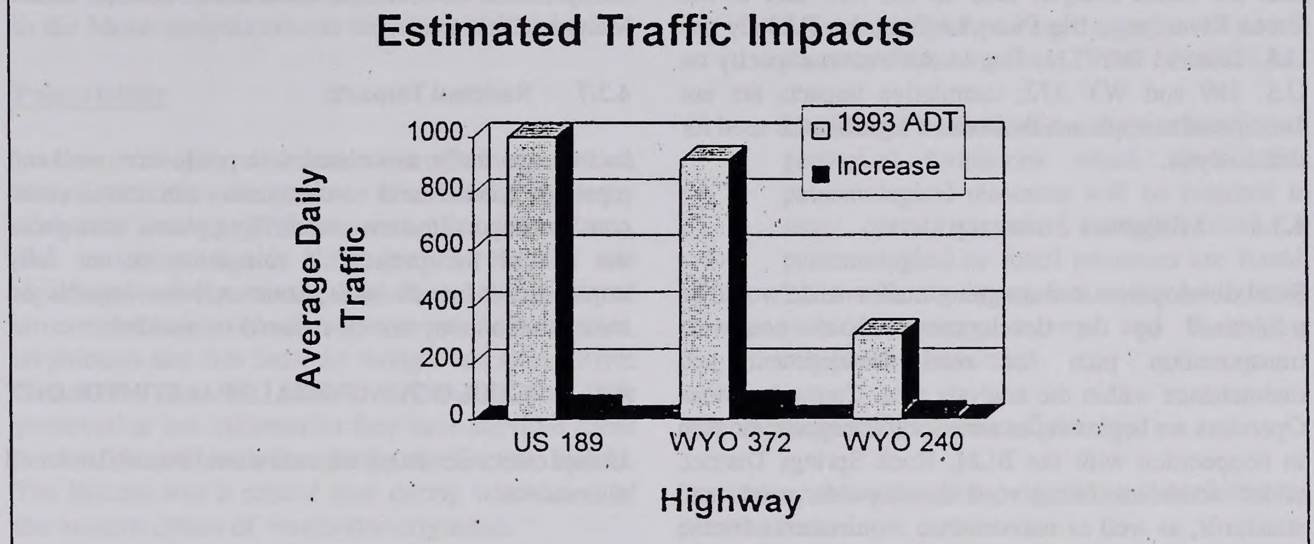

Exhibit 4-2. Estimated Traffic Impacts for U.S. 189, WY 372, and WY 240.

the WOGCC. As with Alternative A, the potential increase in traffic would not be significant.

4.3.4 Impacts Summary

The increases in traffic associated with the Proposed Action and, to a lesser degree, Alternative A would create greater direct impacts when compared to Alternative B. These impacts would occur throughout the ten-year drilling program. Due to the good condition and excess capacity of the highways within the analysis area, these impacts are not considered significant.

4.3.5 Cumulative Impacts

At present, no other major industrial development is anticipated within the analysis area. Just outside the eastern boundary of the analysis area, development and expansion of trona mining and soda ash processing facilities and development of a methanol processing plant are planned for western Sweetwater County. Construction- and operations-related traffic associated with these facilities would create cumulative effects only on I-80. Given that I-80 is designed and maintained as an Interstate highway, deteriorations in levels of service are not anticipated from these cumulative impacts.

Currently, the greater Green River Basin, which includes the analysis area as well as additional potions of Sweetwater, Uinta, Lincoln, Sublette, and Carbon counties, is anticipated to experience substantial petroleum exploration and development activity over the next several years (Geological Survey of Wyoming 1994). Since the major highways providing access to the analysis area also provide access to other fields in the western portion of the Green River Basin, it is likely that other oil and gas drilling projects would generate cumulative transportation impacts for these major highways (i.e., I-80, U.S. 30, and U.S. 189). Projections of increases in ADT are not available for other planned exploration and development activities. However, given that the planned exploration and development activities are all substantially smaller than the Proposed Action, it is unlikely that cumulative oil and gas activities will result in cumulative impacts which would exceed the significance criteria established for this analysis.

Projects on the east side of the Green River (e.g., Fontenelle, Lincoln Road, Stagecoach Draw, and Jonah Field) would likely use WY 191 for access. Projects near the Moxa analysis area on the west side of the Green River (e.g., Big Piney/La Barge) will likely use U.S. 189 and WY 372. Due to the excess capacity on U.S. 189 and WY 372, cumulative impacts are not anticipated to approach the level of significance used for this analysis.

4.3.6 Mitigation Summary

Road development and on-going maintenance would be minimized by the development of an area-wide transportation plan for road development and maintenance within the analysis area. Currently, Moxa Operators are beginning an area-wide transportation plan in cooperation with the BLM, Rock Springs District, which addresses future road development needs and standards, as well as maintenance requirements for the existing transportation system. The transportation plan is expected to be completed within twelve months of approval of the Expanded Moxa Arch Natural Gas Development project. This transportation plan should identify the minimum road network that would be required to support the drilling plans of each operator. Existing roads should be used as collectors and local roads whenever possible to minimize new surface disturbance within the area. Standards for road design should be consistent with BLM Road Standards Manual Section 9113. The transportation plan should also address the issue of road maintenance agreements between the Operators.

Permits are required from the appropriate county for access to or across a county road or for pipeline crossings of a county road. These permits should be acquired prior to construction of additional roads. All roads on public lands which are not required for operation and maintenance of field production should be permanently blocked, re-contoured and reseeded. Roads on private lands should be treated similarly depending on the desires of the land owner.

The Operators of the field will be responsible for preventive and corrective maintenance of roads in the analysis area throughout the duration of the project. This may include blading, cleaning ditches and drainage facilities, dust abatement, noxious weed control, or other requirements as directed by the BLM.

Not all mitigation measures and/or BLM road guidelines may be applied on non-federal lands as described previously. Therefore, there may be some inconsistency in the service level and/or construction of roads in the Moxa analysis area.

4.3.7 Residual Impacts

Increases in traffic associated with production, well and pipeline service and reclamation activities would continue beyond the ten-year drilling phase, throughout the life of the project. If mitigation is not fully implemented for all lands, some adverse impacts on transportation may not be reduced or avoided.

4.4 GEOLOGY/MINERALS/PALEONTOLOGY

Unless otherwise noted, impacts would be similar for all alternatives.

4.4.1 Introduction

Geology

Impacts could occur to the geologic environment caused by project construction and operation (e.g., alteration of existing topography, initiation of landslides and mass failures, etc.) or impacts could occur to project facilities as a result of inherent geologic hazards.

Mineral Resources

With the exception of petroleum reserves, there are no major mineral resources that would be significantly impacted by implementation of the Moxa Arch project. Implementation of the proposed project could beneficially and detrimentally affect mineral resources in the Moxa analysis area. The proposed project would allow recovery of the federal natural gas resources per 43 CFR 3162(a) and would allow for effective management of the resource to minimize draining of the federal reserves from non-federal lands. Private and public revenues would be generated through implementation of this proposal. Potential adverse impacts of the proposed project include disruption of other on-going mineral development activities. The "Known Sodium Leasing Area" (KSLA) is located along the east margin of the Moxa analysis area. Well completion and casing techniques that do not include protection of mixing groundwater and leakage of natural gas into the trona deposits could adversely affect the trona mining industry in the area. Recent BLM policy has been developed in cooperation with the WOGCC, Petroleum Association of Wyoming (PAW), and the Moxa Operators, to formally protect the trona deposits in the Moxa analysis area as described in Chapter 2.

Paleontology

Inventory of paleontologic resources in the Moxa analysis area show the presence of sedimentary deposits of middle Eocene age that contain plant, invertebrate, and vertebrate fossils of scientific interest and significance. Of particular importance are fossils of terrestrial vertebrates including mammals, birds, reptiles, amphibians and fish from the Bridger and Green River formations that are known world-wide for their preservation and information they have provided about animal life and evolution during the Eocene Epochs. The Eocene was a critical time during which most of the modern orders of vertebrates originated.

4.4.2 Resource Management Objectives and Impact Significance Criteria

4.4.2.1 Resource Management Objectives

Geology

- Activities in areas of known geologic hazards will be restricted. Appropriate mitigating measures will be developed.

Mineral Resources

Public lands within the Moxa analysis area have been determined suitable for oil and gas leasing and development.

Paleontology

- Authorizations for surface-disturbing operations will be conditioned to minimize adverse impacts to paleontological resources.
- Operations causing disturbance in the Green River Formation will require a paleontological survey by a qualified paleontologist, and mitigating measures will be required as appropriate. For surface disturbance in other vertebrate-bearing formations, including the Bridger and Wasatch, a survey may be required, depending on the extent of the proposed disturbance and the proximity of known paleontological sites.
- A paleontologist must have an approved permit from the Wyoming State Office of the BLM.
- Holders of authorizations for actions in all geological formations which may affect paleontological resources will be required to stop operations and contact BLM if paleontological or fossil resources are found. BLM will take appropriate action which may include requiring surveys and developing mitigation measures.

4.4.2.2 Impact Significance Criteria

Impacts would be considered significant if the following were to occur:

Geology

- project facilities were damaged due to seismic events, landslides, subsidence, or flooding.
- project activities resulted in landslides, subsidence, or increased flooding.

Mineral Resources

- access to economically recoverable resources were restricted
- attainment of maximum ultimate recovery of oil/gas resources were unnecessarily precluded from existing leases.

Paleontology

Adverse impacts to fossils resources occur when fossils of scientific significance are damaged or destroyed by construction. Significant impacts occur when scientifically significant nonrenewable fossil resources are damaged or destroyed as a result of construction activities.

Although all fossils contain some scientific information, few paleontologists consider all fossils to have scientific significance. Wyoming BLM guidelines consider all vertebrate fossils to be of scientific interest and other types of fossils may also be placed in this category. The BLM provides no guidance on evaluating the significance of fossil resources, but professional paleontologists generally recognize fossils and their containing deposits to be of significant scientific value or significance if they provide taphonomic, taxonomic, phylogenetic, ecologic, or stratigraphic information. Significant fossil or fossil resources can only be determined by a qualified paleontologist.

4.4.3 Direct and Indirect Impacts

Geology

The inherent geologic hazards in the analysis area do not pose significant danger or public safety hazard. As a result, impacts related to natural geologic hazards would not likely occur due to topographic alteration resulting from drill site, access road, and pipeline construction. As discussed in Chapter 3, no major landslides have been mapped within the analysis area, and slope gradients are relatively mild over most of the area. Construction activities would not incite landslides, mudslides, debris flows, or slumps. Seismic activity is low, so the potential for damage of project facilities would be minimal.

Mineral Resources

Implementation of either action alternative could adversely affect the trona deposits and mines as discussed previously. Recent BLM policy has been developed to minimize potential adverse effects be requiring effective well completion through cementing and casing. Implementation of Alternative B (No Action) would reduce the ability of the BLM to effectively manage the federal natural gas resource. Drilling on private lands within the Moxa analysis area would deplete the federal resource without generating the anticipated revenues and subsequent benefits. An optimum development of the field would not be possible.

Paleontology

It is very likely that ground disturbance associated with construction of the project will encounter fossils of scientific significance. Direct damage or destruction of these fossils as a result of construction, with subsequent loss of scientific information, is of primary concern as an adverse impact of the project. Adverse impacts indirectly associated with construction are of additional concern. For example, fossils may be subject to damage or destruction by erosion that is accelerated by construction disturbance. In addition, improved access and increased visibility as a result of construction of roads to well pads and other facilities may cause fossils to be damaged or destroyed as a result of unauthorized collection and resultant vandalism.

Adverse impacts to fossil resources are most likely and could be significant at known fossil localities or in places where geologic deposits with a high paleontologic potential are exposed at or near the surface. Deposits are considered to have a high paleontologic potential if they were known to yield scientifically significant fossils anywhere in the region of southern Wyoming. Adverse construction impacts to paleontologic resources are possible and probable at well sites and where access road construction beyond minor alteration occurs in these same areas.

Adverse impacts to fossil resources may be less likely and of unknown significance where geologic deposits with an unknown paleontologic potential are exposed at or near the surface. Deposits are considered to have an unknown paleontologic potential if either not enough information was known about their fossil-producing nature in the area, or their lithology, age and depositional environment suggested they should be fossil-bearing but fossils have yet to be reported from them. Adverse impacts to fossil resources are not likely and probably not significant in areas underlain at the surface or near surface by geologic deposits with a low paleontologic potential. Deposits are considered to have a low potential if they have been documented to lack significant fossils, or that may contain common and nonsignificant fossils, or non-diagnostic fragmentary fossil remains.

Not all impacts of construction are adverse to paleontology, however. Excavation can reveal fossils of significant scientific interest that would have otherwise remained buried and unavailable for scientific study and in this way can be beneficial. The mere revelation of fossils of scientific importance is in itself not a beneficial impact. To have beneficial impact, such fossils must be properly collected and catalogued into the collection of a museum repository so that they are available for scientific study.

The relative magnitude of potential construction impacts to paleontologic resources is related to the paleontologic potential of the sedimentary deposits disturbed during construction, the nature and extent of the disturbance, and the significance of the fossils disturbed. Paleontologic potential, as described above, is a measure of the probability that a deposit will contain not just fossils, but fossils of scientific significance.

4.4.4 Impacts Summary

As discussed in Chapter 2, Section 2.2.4.2.5, the mitigation measures presented in the Soils and Water Resources sections would avoid or reduce potential impacts to the geologic environment to non-significant levels.

Implementation of the Proposed Action involves the development of a maximum of 1,325 well locations and associated production facilities and as a result would have direct and indirect impacts to fossil resources. Alternative A involves a Minimum Development scenario of 795 wells within the analysis area in addition to existing operations and would also have direct and indirect impacts to fossil resources. Alternative B (No Action), which would allow on-going natural gas production activities and previously authorized APD and right-of-way (ROW) actions on a case-by-case basis, would also involve the development surface and subsurface oil and gas facilities and would also have direct and indirect impacts to fossil resources. The magnitude of impact to fossil resources, would vary dependent on the total number of wells and extent of ancillary facilities developed. The magnitude of impacts that may occur, though unknown at this time, would depend on the specific action taken and the specific area involved. The potential types of adverse direct and indirect impacts to fossil resources are identical to those described for the Proposed Action.

4.4.5 Cumulative Impacts

No cumulative impacts to geologic or fossil resources are anticipated from implementation of the Proposed Action or Alternative A if mitigation measures described below are implemented.

4.4.6 Mitigation Summary

4.4.6.1 Geology

No mitigation would be required since impacts are not expected to occur to the geologic environment or to project-related facilities due to geologic hazards.

4.4.6.2 Mineral Resources

Since adverse impacts to mineral resources are not anticipated, no mitigation is required.

4.4.6.3 Paleontology

The BLM and other federal agencies require that potential adverse impacts of project implementation to fossil resources identified by the Class I survey must be addressed and appropriate procedures for mitigating those impacts must be developed prior to construction in order to satisfy environmental requirements.

To reduce the potential for significant adverse impacts to non-significant levels, mitigation measures would be implemented in the Moxa analysis area on a project-by-project basis. Mitigation measures to reduce adverse impacts are implemented prior to or in conjunction with ground disturbance and may include any or all of the following: 1) worker education, 2) monitoring of excavation, 3) collection and sampling of significant fossils, or 4) relocation of excavation to avoid fossils of significance. Mitigation measures are specifically designed to reduce adverse impacts of construction to fossil resources to non-significant levels. Mitigation measures may be both general and specific.

General Measures

General measures would mitigate adverse impacts to fossil resources that may occur anywhere in the analysis area, including areas of low paleontologic sensitivity. These measures are consistent with standard practice for paleontologic work within the professional paleontologic consulting community. The following measures are considered standard practice and will be applied to the Moxa analysis area on a project by project basis:

Worker Education. Qualified paleontologists instruct construction personnel about the types of fossils they could encounter and the steps to take if they uncover fossils anywhere during construction of the project. This measure is particularly important in areas of low paleontologic potential that are unlikely to produce significant fossils but that are not monitored by a qualified paleontologist.

Discovery Contingency. Contingency is made for the unlikely event that significant fossils are discovered in areas that are not monitored during construction. Usually construction activities which could adversely affect the fossils are redirected until a qualified paleontologist has determined the importance of the uncovered fossils, the extent of the fossiliferous deposits, and made and implemented recommendations regarding further mitigation, if any are warranted. Qualified paleontologists should make every effort to minimize and eliminate construction delays.

Specific Measures

Specific measures would be enacted to mitigate adverse impacts to fossil resources in areas of high and unknown paleontologic sensitivity on a project-by-project basis. Areas of high paleontologic potential include any area underlain at the surface, or within a few feet of the surface, by the Green River and Bridger Formations as shown in Chapter 3, Exhibit 3-2. These measures are consistent with standard practices for paleontologic work within the paleontologic consulting community and include the following:

Class III Field Survey. Prior to construction disturbance, areas of high or unknown paleontologic potential identified during the Class I survey will be surveyed by a qualified paleontologist to identify the location and extent of fossil resources. The Class III survey can be completed any time prior to implementation of the project, and a report of findings, as described below, is completed following the completion of the Class III survey.

Mitigation Planning. Areas of high paleontologic potential will be field surveyed by a qualified paleontologist to identify and quantify the presence or potential presence of significant paleontologic resources on a project-by-project basis. Following survey, a plan would be developed and implemented by a qualified paleontologist and would address treatment of specific areas if significant fossils are either identified within the specific project boundaries or have a high probability to be uncovered within the area.

Mitigation of ground-disturbing impacts would be conducted prior to or in conjunction with construction and could and may involve 1) minor design modifications, such as shifting the location of an access road in order to avoid direct effects; 2) recovering scientific information from paleontologic localities by conducting research on identified localities prior to construction; or 3) monitoring excavations. This assumes that important scientific data would be adequately recovered from significant localities that cannot be avoided. Data gathering could and may include 1) collection of mega-fossils remains, 2) processing of fossil-bearing sediment for screen-wash processing for micro-fossil remains, and 3) recording appropriate geologic data. All work will be conducted by a qualified paleontologist.

Fossils of significance collected in the field, or secured via screen-washing during or following any Class III field survey or subsequent mitigation work, will be curated into the permanent collections of a museum repository acceptable to the lead government agency for the project. Curation will include preparation of specimens to the extent of identification and completion of accompanying locality and specimen data into archive records.

Submission of a Final Technical Document. Adverse impacts to paleontologic resources are usually not considered reduced to non-significant levels until a final technical report is prepared and submitted following completion of Class III surveys and the mitigation program, if one was implemented. If a mitigation program was implemented, the report contains the results of the surveys and mitigation work conducted, including an accession list of fossil specimens collected and listed by locality. If no mitigation was conducted, the report contains the results of the survey.

The report should contain a discussion of the scientific significance of the specimens and geologic and paleontologic setting of the fossils and their localities. A confidential appendix containing copies of maps and data sheets for each locality, if any specimens were discovered and collected, should be appended to the report. Copies of the report should be filed with the project proponent, agencies involved, and with the repository where the fossils are curated.

The supervising, qualified paleontologist for the project is responsible for the assessment and development of the program for mitigation during the initial planning phase, the adequacy of the mitigation measures, and the report of findings as set forth in BLM IB WY-93-371.

4.4.7 Residual Impacts

Geology

None of the alternatives would have residual impacts.

Mineral Resources

The action alternatives would have no residual impacts; however, Alternative B would inhibit the extraction of mineral resources on federal lands.

Paleontology

If mitigation measures are applied consistently for all lands, there would be no residual impacts to paleontologic resources. If all measures are not applied on all lands, impacts would be of a greater magnitude than indicated in this EIS.

4.5 SOILS

4.5.1 Introduction

Potential impacts resulting from drill pad, access road, facility site, and pipeline ROW construction could include removal of vegetation, exposure of the soil, mixing of soil horizons, soil compaction, loss of topsoil productivity, and increased susceptibility of the soil to wind and water erosion. These adverse effects could minimize the success of reclamation and revegetation efforts. For the purposes of this document, successful reclamation and/or revegetation refers to returning a disturbed area to a condition of productivity and use in similar condition as the pre-disturbance condition. These conditions include watershed stability, erosion condition, and plant species composition and structure as discussed in greater detail in Appendix B. Successful reclamation is qualified as short-term attainment of native plant cover comparable to 50 percent of predisturbance cover in three years and 80 percent in five years. The long-term performance standard is reestablishment of the native plant community.

Prime farmland soils as well as farmland soils of State and local importance do not occur in the analysis area and therefore would not be adversely affected by the project. The following sections are a summary of the more detailed analysis of soil impacts presented in the Soil and Water Resources Technical report (ECOTONE 1995a).

4.5.2 Resource Management Objectives and Impact Significance Criteria

4.5.2.1 Resource Management Objectives

The Kemmerer RMP (USDI-BLM 1986), which applies to federal lands unless otherwise determined during APD, prescribes 34 management objectives and standard stipulations for soils and watershed management pertaining to this project. These are detailed in the RMP and in the Soils and Water Resources Technical Report (ECOTONE 1995a). In general, these management directives relate to minimizing or prohibiting surface disturbance in certain conditions and providing for effective reclamation and site stabilization.

4.5.2.2 Impact Significance Criteria

The following criteria were used to determine the importance of impacts to soils within the Moxa analysis area:

- non-compliance with the RMP;
- increased soil erosion that cannot be reduced by 50 percent after one year and by 75 percent after five years of soil disturbance;
- failure to have successful revegetation within three to five years of implementation;
- a reduction in soil productivity to a level that minimizes or prevents the disturbed area from recovering to pre-disturbance soil productivity levels;
- location and construction of project facilities on sensitive soils defined in Section 3.5.3 without adequate mitigation and control measures in place; and/or
- the proposed project increases the total cumulative soil disturbance within the Moxa analysis area and the total cumulative impact analysis (CIA) area to more than a total of ten

percent. Ten percent was selected as the threshold based on professional judgement.

4.5.3 Direct and Indirect Impacts

4.5.3.1 Proposed Action

Project activities could result in adverse impacts to soils including the removal of vegetation, exposure of the soil, mixing of soil horizons, soil compaction, loss of topsoil productivity, and increased susceptibility of the soil to wind and water erosion. These impacts could increase runoff, erosion, and off-site sedimentation.

Construction of the Proposed Action would variously disturb approximately 20,293 acres of soils in the short term due to drill pad, road ROWs, pipeline ROWs, and ancillary facilities. This total would include 6,625 acres for drill sites and associated facilities (assuming five acres of disturbance per drill pad including drill pad, topsoil and spoil storage areas, cut and fill , and ancillary facilities), 4,823 acres for access road ROWs (assuming 3.64 acres per well site at a road construction ROW width of 50 feet), 8,838 acres for pipeline ROWs (assuming 6.67 acres per well site at a pipeline construction width of 50 feet), and a seven-acre compressor station.

Once a well goes into production, the size of the drill pad can be reduced and the unused portion reclaimed pursuant to the RMP and as described in Section 2.2.3.6, Chapter 2. Similarly, all other unused portions of roadway ROWs and the complete pipeline ROW would be reclaimed upon production. Assuming all wells are productive, the total area of impact (i.e., unreclaimed area actively used for production) would be reduced upon successful reclamation to approximately 5,691 acres including 2,782 acres for well pads (2.1 acres per pad), 2,902 acres for roads, zero acres for pipelines, and seven acres for the compressor station. This would represent 1.2 percent of the analysis area.

Sensitive Soils. Because sensitive soils (see Exhibit 3-4) are distributed throughout the analysis area, total avoidance would not be possible. Locations have not yet been identified for wells, pipelines, and roads; therefore, site-specific impacts cannot be assessed in this EIS. However, based on frequency of occurrence in the analysis area, an estimate of the ability to avoid the most severe of the sensitive soils within the analysis area can be assessed. Approximately 390,500 acres or 82 percent of the analysis area (including 37,000 acres of saline/sodic bottomland soils, 6,200 acres of floodplain soils beyond 500 feet of live streams, 20,000 acres of sand dunes, and 327,300 acres of non-sensitive soils) could be developed without significant impact assuming best management practices (BMPs) and mitigation measures are implemented (ECOTONE 1995a).

Approximately 50 percent of the sand dune soils could be developed since project facilities could be located on non-sensitive inclusions within this type. Most of the saline/sodic bottomland soils could be developed for roads and well sites without significant impact. This conclusion is based on 1) the ability to overcome bearing strength problems with special engineering and construction measures such as use of imported earth materials that provide adequate bearing strength, 2) the limited natural vegetal cover being effectively replaced with standard revegetation practices, and 3) minimum cutting and profile disturbance required on these relatively flat areas. The potential for significant impact is sufficiently high that such areas should be avoided where feasible. However, the importance of avoiding these areas is not as great as for other sensitive soil units since their sensitivities can be overcome with special engineering and construction and because they have relatively flat gradients. Due to the fine-textured soils in the saline/sodic bottomlands, surface runoff, erosion, and sedimentation are major concerns that must be addressed during APD approval.

Badland and steep slope sensitive soils should be avoided due to high erosion rates and very poor reclamation potential. Erosion rates in great excess of those identified below would occur on these steep slopes. Minimal topsoil and high erosion rates greatly restrict reclamation success on these slopes. Further, such slopes are highly visible and such disturbances would degrade visual resources in the analysis area as described in Section 4.11. In order to preclude significant impacts, roads, drill/well sites, and pipelines should not be placed in areas with steep slopes greater than 25 percent, areas with badland soils or sand dune soils. Where avoidance is not feasible, special erosion control and soil stabilization measures should be applied as described in the guidelines presented in Appendix B.

Finally, significant impacts to floodplain and wetland soils (Exhibit 3-4) could occur if project facilities were located on those areas. Placement of project facilities will need to avoid these areas. Frequent saturation and inundation render these soils unsuitable for development due to poor bearing strengths and flooding hazard. Wetlands are covered in greater detail under Vegetation, Section 4.8. The RMP specifies no surface occupancy be 500 feet of live streams. Assuming that this is the important breakpoint between critical and non-critical floodplain soils, approximately 50 percent of floodplain soils fall outside this breakpoint. The portion of the floodplain located outside the 500-foot buffer zone is not subjected to frequent flood events nor to a shallow water table having an adverse effect on bearing strength. Therefore, development in floodplain soils outside of the 500-foot buffer zone would likely not result in significant impacts to soils.

In summary, there is a high probability that development would occur on non-sensitive soils or on sensitive soils that can be developed without significant impacts by using special mitigation measures. However, not all sensitive soils (i.e., sand dunes, steep slopes, and badlands) could be avoided given their elongated shape and relatively high density of occurrence. Given the sensitivity of the soils described previously, unauthorized off-road vehicle use should be restricted to reduce indirect impacts from off-road use of vehicles such as vegetal cover destruction, rutting, and compaction of the soil. Development of the transportation plan would include avoidance of sensitive soils in the planning process.

Reclamation. If handled incorrectly, the removal and salvage of topsoil for revegetation purposes could reduce the natural fertility of the soil or cause coarse fragments from the subsoil to be mixed into the topsoil, thus decreasing its reclamation potential. This in turn could inhibit reclamation success such that successful reclamation may not be completed in three to five years.

Topsoil quality in the Moxa analysis area is very poor to poor for the sensitive soils, except for most wetland soils and floodplain soils where topsoil quality is fair to very good, and poor to good for the non-sensitive soils. Limitations to topsoil quality include stoniness, high salt content, thin soils, very sandy soils, doughtiness, high coarse fragment content, and naturally low fertility levels. These limitations are described in greater detail in the Soils and Water Resources Technical Report (ECOTONE 1995a). In addition to these limitations, low annual precipitation and wind and water erosion could make successful revegetation in the analysis area more difficult to attain. Subsequently, revegetation potentials range from mostly very poor to poor in a majority of the sensitive soil areas (i.e., badlands, sand dunes, and saline/sodic bottomland soils) and fair to good for the balance of the soils (steep slopes, wetlands, floodplains, and non-sensitive soils).

Erosion. Successful revegetation through applied surface runoff, erosion, and sediment control measures, and effective revegetation efforts would reduce the potential for soil productivity loss; therefore, soil erosion would likely be the primary adverse impact of the proposed project. Soil compaction caused by equipment traffic or by increased raindrop impact after loss of surface cover may decrease infiltration and water storage capacity, increase runoff, and reduce soil productivity. Increased surface runoff and erosion would occur primarily in the short term and would decline in time due to natural stabilization. Increases in surface runoff would also depend on the success of mitigation measures.

Increased susceptibility to erosion--primarily water erosion but with some wind erosion--would occur in newly disturbed areas. Erosion can impede successful revegetation, reduce site productivity, and impair water quality if eroded sediment is transported to surface water bodies. Some soils and geologic units may have relatively high levels of selenium such as in badland soils and sodic/saline bottomland soils. Erosion of selenium-laden sediment could increase selenium loading of streams.

Wind erosion could be an adverse effect of project development in the sand dune sensitive soil type. However, wind erosion is not expected to be a widespread problem across the Moxa analysis area. Chronic and severe wind erosion could occur in limited areas where roads and/or pipelines traverse non-cohesive sand dune soils. As discussed previously, a large portion of the sand dune polygons include inclusions of less-sensitive soils. Soil loss in exposed sand dune soils could be as high as 50 t/ac/yr. As described for water erosion, most wind eroded soil particles are deposited in close proximity to the site of detachment. However, local points of soil loss can be so great that a vegetal cover cannot be maintained. Because the sandy portions of these delineations are particularly susceptible to "blow outs," special efforts to avoid such areas should be applied.

Soil loss tolerance within the analysis area is approximately two tons/acre/year (t/ac/yr); losses exceeding this amount would substantially lower soil productivity. In regard to general soil erosion, most sediment is generated from exposed areas that cover only a small portion of the analysis area. As discussed in the Soils (3.5.2) and Water Resources (3.6.2.1) sections of Chapter 3, sediment delivery has been estimated to be approximately 0.29 acre-feet (ac-ft) per square mile per year or 1.1 t/ac/yr. The majority of sediment delivery originates from erosion and degradation of stream channels as opposed to soil erosion away from channels. Therefore, baseline or current erosion does not exceed the soil loss tolerance.

The Universal Soil Loss Equation (USLE) was used to evaluate the increased soil erosion due to implementation of the proposed project, both with and without application of erosion control measures. As indicated in Chapter 3, baseline rate of 0.7 t/ac/yr is an environmentally conservative (i.e., worst-case) estimate, and the true natural baseline erosion rates are likely less than the value presented here. Recall that this procedure does *not* predict absolute magnitudes of erosion; rather, it provides an indication of the relative magnitude of soil erosion. ECOTONE (1995a) describes the application of this estimation technique in detail. This magnitude correlates with the BLM's estimate of 1.1 t/ac/yr. Most of the predicted eroded soil is contained on-site and is not transported off-site to streams as discussed in Section 4.6.3.1.

Table 4-7 summarizes total erosion that could occur under this alternative with and without erosion control measures. A brief example illustrates how to read this table: For Year 1 with erosion control, newly constructed pipelines would experience an erosion rate of five t/ac/yr. This value, multiplied by the area of pipelines (8,838 ac) under the Proposed Action, would result in a predicted erosion rate of 44,190 t/yr.

Applying the same technique to newly disturbed soils, the average unmitigated erosion rate could be as high as three t/ac/yr for drill pads, 18 t/ac/yr for pipelines, and ten t/ac/yr for roads. New project facilities would be constructed with surface runoff, erosion, and sedimentation controls in place that would reduce erosion rates. The effect of applying control measures to reduce erosion was investigated by Grah (1989) through the use of the USLE to demonstrate the feasibility of erosion reduction. Control measures include the use of mulch, water bars, and effective revegetation.

Applying control measures and assuming a reasonable success rate, erosion from newly disturbed areas could be reduced to two, five, and three t/ac/yr in the first year for drill sites, pipelines, and roads, respectively. As discussed previously, erosion would continue to decrease due to natural stabilization and a maturing vegetal cover. By the fifth year after construction, erosion would likely be reduced to one, two, and two t/ac/yr for well, pipelines, and roads, respectively. This represents a 67 percent reduction for well sites, 89 percent reduction for pipelines, and an 80 percent reduction for roads. Erosion reductions for well sites and roads would not decrease as much as for pipelines since exposed earth material that comprise the surface of these features would continue to be exposed to erosion. These calculations suggest that soil erosion could be reduced to non-significant levels identified in the significance criteria with application of the reclamation guidelines presented in Appendix B.

With the application of erosion control measures, total erosion from the Proposed Action would be approximately 71,923 t/yr after the first year of construction and 33,954 t/yr after the fifth year. These estimates assume that all construction would occur in the first year of project authorization. As discussed in Chapter 2, project development would occur over a ten-year period. Therefore, the total estimated erosion would be distributed over this period of time and would be less than this worst-case analysis.

The reclamation guidelines presented in Appendix B are general in scope because they apply to the total Moxa area, an area with highly variable and diverse conditions. The guidelines were developed to generally address the reclamation management directives identified above and presented in the RMP (USDI-BLM 1986). The ultimate reclamation that would be applied would be developed for a specific facility during the APD-approval process based on site-specific conditions, coordination with the BLM in regard to specific reclamation requirements on federal lands, and coordination with private landowners and managers of State lands. This analysis has assumed that the guidelines presented in Appendix B would be applied on all federal and non-federal lands.

Table 4-7. Soil Erosion Rates and Total Erosion by Alternative.

Facility	Area (acres)	Year 1		Year 5	
		Without Erosion Control	With Erosion Control	Without Erosion Control	With Erosion Control
Erosion Rates (t/ac/yr)					
Well Pads	--	3	2	2	1
Compressor Station	--	3	2	2	1
Pipelines	--	18	5	4	2
Roads	--	10	3	8	2
Predicted Erosion (t/yr)					
Proposed Action (t/yr)					
Well Pads	6,625	19,875	13,250	13,250	6,625
Compressor Station	7	21	14	14	7
Pipelines	8,838	159,084	44,190	35,352	17,676
Roads	4,823	48,230	14,469	38,584	9,646
TOTAL	**20,293**	**227,210**	**71,923**	**87,200**	**33,954**
Alternative A (t/yr)					
Well Pads	**3,975**	**11,925**	**7,950**	**7,950**	**3,975**
Compressor Station	**7**	**21**	**14**	**14**	**7**
Pipelines	**5,303**	**95,454**	**26,515**	**21,212**	**10,606**
Roads	**2,894**	**28,940**	**8,682**	**23,152**	**5,788**
TOTAL	**12,179**	**136,340**	**43,161**	**52,328**	**20,376**

Most wind- and water-eroded soil particles are deposited in close proximity to the site of detachment; however, local points of soil loss can be so great, particularly in sand dune soils, that a vegetal cover cannot be maintained. Soil loss above two t/ac/yr would substantially lower soil productivity. Increased surface runoff and erosion would occur primarily in the short term, would decline in time due to natural stabilization, and would depend on the success of mitigation measures. Provided avoidance of sensitive soils is optimized, management directives are complied with, and effective reclamation is implemented, significant impacts are not expected to occur with implementation of the Proposed Action.

4.5.3.2 Alternative A

Implementation of Alternative A would involve temporary disturbance of 12,179 acres, or 8,114 fewer acres of construction impacts than the Proposed Action. This total acreage would be comprised of 3,975 acres for drill pads, 5,303 acres for pipelines, 2,894 acres for roads, and seven acres for the compressor station. Production phase impacts would be reduced to 3,417 acres or 0.7 percent of the analysis area (approximately 1,669 acres for well pads, 1,741 acres for roads, zero for pipelines, and seven acres for the compressor station).

The same types of soil impacts would occur under this alternative as with the Proposed Action. The amount and duration of such impacts would depend on the locations of the wells and access roads. As discussed previously, it would be very difficult to totally avoid all sensitive soil areas. Slopes greater than 25 percent, badland soils, and wetland soils should be totally avoided. The other sensitive soils should also be avoided, but by following mitigation measures, no significant impacts would likely occur.

Erosion rates would be essentially the same for this alternative as for the Proposed Action since the same types of construction activities would occur. However, total erosion, as indicated in Table 4-7, would be reduced due to the smaller area of disturbance under this alternative. With the application of erosion control measures, total erosion under this alternative would be approximately 43,161 t/yr after the first year of construction and 20,376 t/yr after the fifth year. As discussed under the Proposed Action, the total estimated erosion would be distributed over time and would be less than this worst-case analysis.

These calculations suggest that with application of the reclamation guidelines presented in Appendix B, soil erosion could be reduced to non-significant levels identified in the significance criteria. Assuming avoidance of sensitive soils is optimized, management directives are complied with, and effective reclamation is implemented, significant impacts are not expected to occur with implementation of this alternative.

4.5.3.3 Alternative B - No Action

Under the No Action alternative, soils would continue to be impacted as described above under the action alternatives as APDs are granted by the BLM pursuant to previous authorization. Unquantified additional development beyond the existing level would occur on a case-by-case basis on State and private lands. The magnitude of this additional development would be dictated by the economics and demand for gas production, as well as environmental constraints based on previous authorizations.

Similar erosion, runoff, and sediment control and revegetation measures would be applied under this alternative to minimize adverse impacts to soils. Such methods, if implemented properly, would likely reduce impacts to non-significant levels provided avoidance of sensitive soils and compliance with management direction is effectively accomplished.

Using the same erosion estimation procedures summarized previously, existing erosion from the total area of disturbance (i.e., 25,999 acres) could be as high as three t/ac/yr or approximately 77,997 t/yr. Under this alternative, future development, granted on a case-by-case basis, would likely be similar to Alternative A in regard to magnitude with similar impact levels. The increase in erosion due to additional development activity would also be similar to Alternative A. Therefore, significant impacts are not expected to occur with implementation of the No Action alternative.

4.5.4 Impact Summary

Impacts resulting from drill pad, access road, compressor station, and pipeline ROW construction could include removal of vegetation, exposure of the soil, mixing of soil horizons, soil compaction, loss of topsoil productivity, and increased susceptibility of the soil to wind and water erosion. These impacts could increase runoff, erosion, and off-site sedimentation. During project construction, implementation of the Proposed Action and Alternative A would initially affect 20,293 acres and 12,179 acres of soils, respectively. This would represent approximately 4.3 percent and 2.6 percent of the analysis area for the Proposed Action and Alternative A, respectively. Under Alternative B (No Action), unquantified additional development on a case-by-case basis would continue beyond the existing level of development. Reclamation efforts during well production would reduce respective impacts to a residual of 5,691 acres and 3,417 acres under the Proposed Action and Alternative A, respectively.

Total erosion that could result from the proposed project with effective surface runoff, erosion, and sedimentation control as well as reclamation measures was estimated to be approximately 33,954 t/yr for the Proposed Action and 20,376 t/yr under Alternative A. This erosion would be in addition to the natural baseline erosion as well as the erosion occurring due to existing residual disturbance in the Moxa analysis area.

Although, a third of the analysis area is classified as sensitive soil and such areas cannot be totally avoided, particular attention should be given to avoiding steep slopes greater than 25 percent, badlands, sand dune soils, and soils with high water tables and/or which are subject to inundation thereby minimizing the chance of a significant impact. These impacts could be kept to non-significant levels with application of the mitigation measures in Chapter 2 and the reclamation guidelines presented in Appendix B.

4.5.5 Cumulative Impacts

Per recent BLM guidance (USDI-BLM 1994g) that strongly recommends evaluating cumulative impacts on a watershed basis for natural resources related to watershed function and stability, cumulative impacts for soils includes two components: 1) the Moxa analysis area and 2) all watersheds as designated by the U.S. Geological Survey (USGS) that are overlapped by the Moxa analysis area--called the CIA area. Exhibit 4-3 depicts the location and relationship of the Moxa analysis area and the considered watersheds. A detailed analysis of existing disturbance within the Moxa analysis area and the CIA area is presented in the Soils and Water Resources Technical Report (ECOTONE 1995a).

Moxa Analysis Area. Existing disturbance within the Moxa analysis area was identified, delineated, and mapped using aerial photographs taken in May of 1994. Disturbance areas were delineated and digitized into a Geographic Information System (GIS) for data manipulation and analysis. A detailed analysis of existing disturbance within the Moxa analysis area and the CIA area is presented in the Soils and Water Resources Technical Report (ECOTONE 1995a).

Existing disturbance within the Moxa analysis area, as discussed in Section 2.6.2 and 3.5.2, is approximately 25,999 acres, or 5.5 percent of the 476,261 acres comprising the Moxa analysis area. As summarized in Table 4-8, existing disturbance ranges from 0.2 percent of a hydrologic unit to 10.5 percent, with an average disturbance per hydrologic unit of approximately 4.0 percent. This indicates that existing disturbance is not uniformly distributed across the Moxa area and reaches an important threshold of ten percent in some units. Of the total existing disturbance, approximately 13,965 acres are in various stages of reclamation to predisturbance cover conditions. The residual existing disturbance, 12,034 acres or 2.5 percent of the analysis area, is currently being used and not subject to reclamation at this time. Taking this into account, residual disturbance within specific hydrologic units ranges from less than 0.1 percent to 4.6 percent. Although residual disturbance is considerably less than total disturbance, these percentages of hydrologic units shown in Table 4-8 are still relatively high.

During the construction phase, the Proposed Action would add 20,293 acres of impact for a total cumulative disturbance area of 46,292 acres, or 9.7 percent of the analysis area. Alternative A would increase existing disturbance by adding 12,179 acres of impact for a total cumulative disturbance area of 38,178 acres or eight percent of the analysis area. Under Alternative B, additional surface disturbance beyond the existing 25,999 acres would occur on an undetermined area on case-by-case basis.

Impacts within the analysis area would be reduced upon reclamation of pipeline ROWs, access road margins, and unused portions of the drill pads during the production phase for each alternative. Under the Proposed Action, reclamation would reduce impacts by 14,602 acres to 5,691 acres for a cumulative impact of 17,725 acres or 3.7 percent of the analysis area. Alternative A impacts would decrease by 8,762 acres to 3,417 acres, with residual cumulative impacts totaling 15,451 acres, or 3.2 percent of the Moxa analysis area. As indicated previously, the cumulative impact within the analysis area would not exceed the significance threshold of ten percent.

Cumulative Impacts Analysis Area. The geographic area outside the Moxa analysis area but within the CIA area is approximately 1,544,906 acres in size. This area, combined with the 476,261-acre Moxa analysis area, yields a total CIA area of 2,021,167 acres. The component CIA areas are shown in Exhibit 4-3. Existing disturbance in the portion of the CIA area outside of the Moxa analysis area was initially estimated from USGS

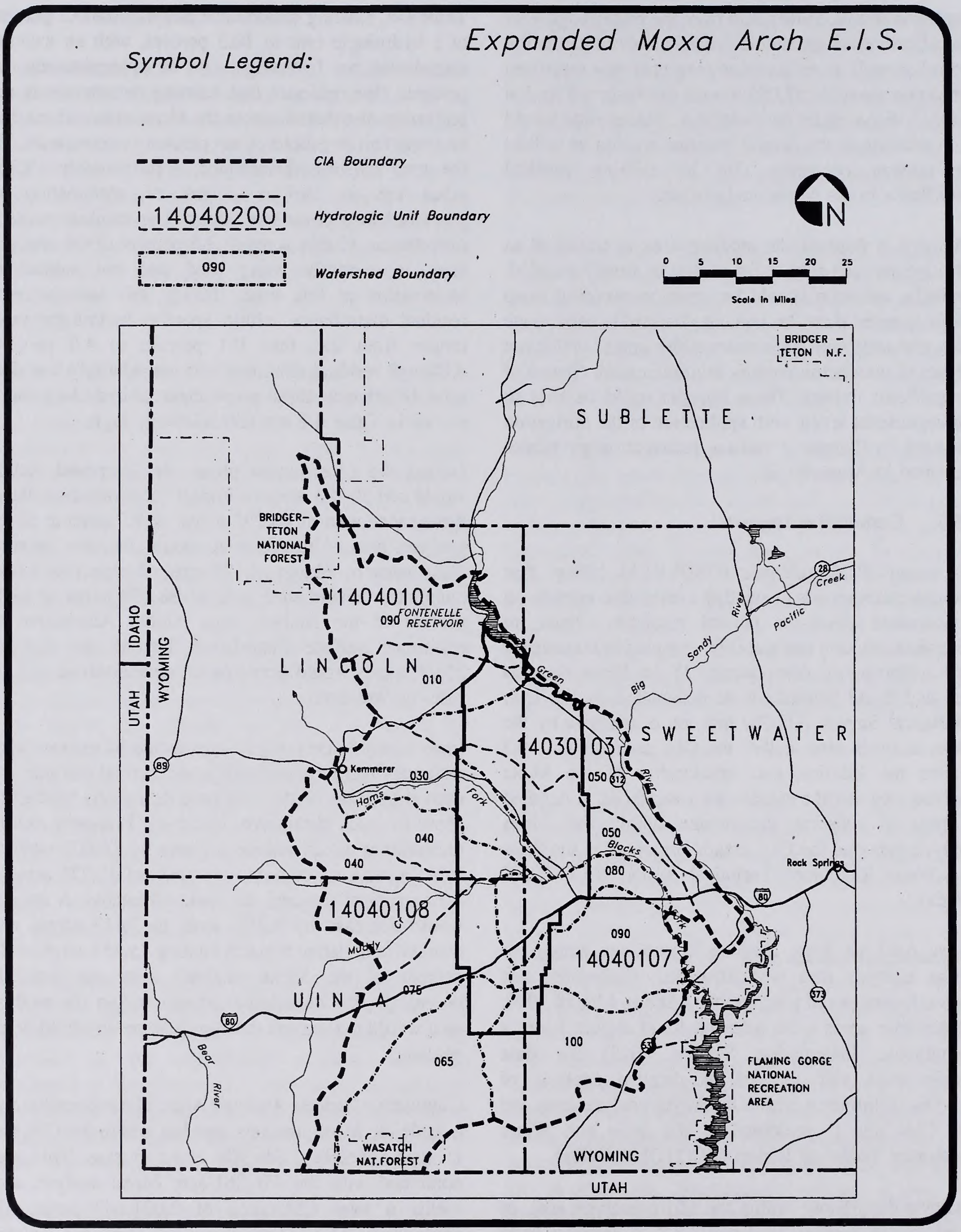

Exhibit 4-3. Watershed and Hydrologic Unit Boundaries Used in the Cumulative Impacts Analysis Area.

Table 4-8. Summary of Total Disturbance and Percent of Hydrologic Unit for the Moxa Analysis Area, the Area Outside Moxa, and for the Cumulative CIA Area.

USGS Watershed/ Hydrologic Unit	Moxa Analysis Area			Outside Moxa			CIA Area		
	Total Area (acres)	Total Disturbance (acres)	Percentage	Total Area (acres)	Total Disturbance (acres)	Percentage	Total Area (acres)	Total Disturbance (acres)	Percentage
14040101090	10,399	282	2.7	87,867	1,028	1.2	98,266	1,310	1.3
14040103010	23,750	443	3.0	140,760	1,434	1.0	164,510	2,147	1.3
14040103050	102,268	5,737	5.6	201,377	2,682	1.3	303,645	8,419	2.8
14040107030	52,945	2,969	5.6	100,730	2,585	2.6	153,675	5,554	3.6
14040107040	24,061	754	3.1	69,185	382	<0.1	93,245	1,136	1.2
1404107050	90,843	6,223	6.9	45,425	1,241	2.7	136,268	7,464	5.5
1404107065	21,745	278	1.3	201,852	1,302	0.6	223,597	1,580	0.1
1404107075	48,441	1,216	2.5	132,257	2,989	2.3	180,698	4,205	2.3
1404107080	64,493	6,777	10.5	38,903	3,350	8.6	103,396	10,127	9.8
1404107090	14,380	602	4.2	149,668	1,135	0.8	164,048	1,737	1.1
11404107100	19,499	443	2.3	198,409	1,222	0.6	217,908	1,665	0.8
14040108040	3,437	5	0.2	178,474	4,830	2.7	181,911	4,835	2.7
Totals	476,261	25,999	(5.5)	1,544,906	24,180	(1.6)	2,021,167	50,179	(2.5)
	Average %		4.0	Average %		2.04	Average %		2.7

topographic maps that were current for 1985. In addition, more recent aerial photographs of portions of the analysis area housed at the Rock Springs BLM District office were reviewed to update the disturbance area estimated from the topographic maps. Aerial photos were not available for the total CIA area. Existing disturbance in portions of the CIA not covered by aerial photographs was estimated based on the level of increased disturbance from topographic maps to current aerial photographs measured in the Moxa analysis area.

Table 4-8 summarizes the total area of existing disturbance (i.e., reclaimed and unreclaimed) for each hydrologic unit within the Moxa analysis area and outside the Moxa analysis area. Approximately 24,180 acres of total disturbance was estimated, or 1.6 percent of the area outside Moxa. On a hydrologic unit basis, percent disturbance ranges from less than 0.1 percent to 8.6 percent. This indicates that total existing disturbance beyond the Moxa analysis area is not uniformly distributed and approaches the ten percent threshold.

Of the total existing disturbance outside of the Moxa analysis area but within the CIA area, approximately 12,988 acres are in various stages of reclamation toward predisturbance conditions. Therefore, the residual existing unreclaimed disturbance, 11,192 acres or 0.7 percent of the CIA area outside Moxa, is currently being used and not subject to reclamation at this time. Taking this into account, residual disturbance within specific hydrologic units ranges from less than 0.1 percent to 3.7 percent. Although residual unreclaimed disturbance is considerably less than total disturbance, these disturbance percentages of hydrologic units are still relatively high. As described previously, impacts due to the Proposed Action would be approximately 20,293 acres of short-term disturbance. This, combined with the existing disturbance in the CIA area outside Moxa (24,180 acres) and within the Moxa analysis area the Moxa analysis area (25,999 acres), would be approximately 70,472 acres or 3.5 percent of the CIA area of 2,021,167 acres. This analysis indicates that the total cumulative impact in the CIA area would not exceed the ten percent significance threshold. Taking reclamation into consideration, total cumulative residual disturbance would be 28,917 acres or 1.4 percent of the CIA area. Therefore, cumulative impacts to soils, in general, would not be significant.

Cumulative impacts under Alternatives A and B would be similar to those described for the Proposed Action, although the magnitude of cumulative impacts would be reduced below the Proposed Action. With effective reclamation as defined in Appendix B, residual disturbances would be well below the ten percent threshold overall for the CIA area.

4.5.6 Mitigation Summary

As with any adverse impact, avoidance of the impact should be considered first. Avoidance of the sensitive soil areas identified in Exhibit 3-4 would be given attention in both the project planning and project construction phases. The distribution of sensitive soils should be specifically taken into consideration during the Transportation Plan development process. Given their wide distribution and density of occurrence, total avoidance would likely not be feasible in all cases. Therefore, special measures or best management practices would need to be implemented to minimize the chance of significant impacts resulting from construction in sensitive soils.

Appendix B presents guidelines that should be considered in minimizing adverse impacts. The measures presented in the guidelines should be applied as needed. Such measures include careful construction and performance monitoring to ensure effective application of control measures. The guidelines presented in Appendix B primarily address the issues of surface runoff, erosion, and sedimentation control as well as effective revegetation of disturbed areas. Incomplete application of these measures, including mulching, could result in failed erosion control and revegetation. Such measures, if applied, would reduce the chance of significant impacts occurring. The Operators are not required to apply the same mitigation measures on State and private lands as on federal land. Therefore, there is a chance that the guidelines presented in Appendix B may not be consistently applied to all areas of the proposed project.

4.5.7 Residual Impacts

No significant unavoidable adverse impacts to soils would occur due to the Proposed Action or other alternatives with the implementation of management directions identified in the RMP, mitigation measures committed to by the Operators as presented in Chapter 2, Appendix A, and the reclamation guidelines presented in Appendix B. Although successful surface runoff, erosion, and sedimentation control is feasible on most of the soils in the analysis area, there is a residual chance of ineffective application of control measures. This could be particularly true on private and State lands where the identified revegetation and erosion control measures are not required as on federal lands.

Significant unavoidable adverse impacts are unlikely given the mitigation measures available to the Operators. However, failure to apply BMPs during the planning, construction, and/or performance monitoring phases could result in significant localized impacts. With reclamation, the ten percent threshold for significant cumulative impacts would not be exceeded for the CIA area (1.4 percent) as well as the 12 hydrologic units that comprise the CIA area.

4.6 WATER RESOURCES

4.6.1 Introduction

Potential impacts that could occur due to project implementation include increased surface water runoff and off-site sedimentation due to soil disturbance (see the Soils Section 4.5); consumptive use of both surface and groundwater; increased salt loading and water quality impairment of surface waters; changes in stream discharge due to project disturbance; changes in groundwater levels, quantity, and quality; and channel morphology changes due to road and pipeline crossings.

The magnitudes of impacts to water resources would depend on the proximity of the disturbance to a drainage channel, slope aspect and gradient, degree and area of soil disturbance, soil character, duration of time within which construction activities would occur, and the timely implementation and success/failure of mitigation measures. Impacts would likely be greatest shortly after the start of construction activities and would likely decrease in time due to natural stabilization, reclamation, and revegetation efforts. Construction activities would occur over a relatively short period (i.e., ten-year period); therefore, the majority of the disturbance would be intense but short-lived.

4.6.2 Resource Management Objectives and Impact Significance Criteria

4.6.2.1 Resource Management Objectives

The Kemmerer RMP (USDI-BLM 1986) prescribes over nine management directions and actions for to water resources and watershed management that relate to this project. In addition, directions identified for soils and vegetation also apply. To briefly summarize, activities will be managed to comply with State and federal water quality standards and to prevent an increase in salinity, minimize erosion, and minimize conflicts between water users.

Other management objectives pertinent to this proposed project include the following:

- the recent (February 24, 1995) KRA guidelines on well completion and casing to protect groundwater quality and prevent migration of natural gas into trona mines that are present within and near the Moxa analysis area as identified in Section 2.2.3.1 and

- the Onshore Oil and Gas Order No. 2, which provides for the protection and isolation of all usable water zones through certain well completion guidelines (see Section 4.6.3.1).

4.6.2.1 Impact Significance Criteria

The following criteria were used to determine significant impacts to water resources:

- non-compliance with management objectives and actions listed above from the RMP (USDI-BLM 1986);

- degradation of water quality such that State standards outlined in the Rules and Regulations of the Water Quality Division of the WDEQ are not met;

- degradation of groundwater quality in aquifers that are directly used as a groundwater source by wells or that discharge into water bodies used for irrigation, domestic purposes, and wildlife and fisheries;

- alteration of channel geometry or gradients that produce undesirable effects such as aggradation, degradation, or side-cutting;

- modification of the quantity and quality of streamflows such that it affects established users;

- non-compliance with the federal Clean Water Act (CWA) and/or State water quality standards; and
- increased salinity loading of the upper Colorado River system due to project implementation which resulted in non-compliance with the Colorado River Basin Salinity Control Act of 1974.

4.6.3 Direct and Indirect Impacts

Additional detail on impacts to water resources is discussed in the Soils and Water Resources Technical Report (ECOTONE 1995a).

4.6.3.1 Proposed Action

Exposure and compaction of the soil surface during project construction could increase water yield and stream flow and degrade water quality in the short term. These impacts would be most severe during the construction phase while soils are in a disturbed state. Impacts would substantially decrease in magnitude during the production phase primarily due to successful reclamation and control measures as well as natural stabilization.

Any increase in quantity of streamflow due to disturbance would be negligible and undetectable due to the relatively small area affected (approximately 20,293 acres total) at any given time and the high degree of surface runoff variability experienced by the ephemeral, intermittent, and perennial streams of the Moxa analysis area. All facility sites (wells, processing plants, etc.) except for pipelines and roads would be located a minimum of 500 feet from surface water features per RMP directives. Effective surface runoff, erosion, and sedimentation control measures would be implemented as described in Chapter 2. Therefore, a significant increase in surface runoff and sediment transport from these disturbed sites would not occur.

Pipelines and roads, being linear facilities, would traverse ephemeral and intermittent stream channels on limited occasions where avoidance of such crossings would not be feasible. The vast majority of such crossings would involve ephemeral channels and vegetated swales. Road crossings would be constructed with sufficiently sized corrugated metal pipe (CMP) culverts, box culverts, or clear-span bridges to competently handle design storm runoff events per BLM road guidelines. Similarly, the crossings would minimize modifications of channel morphology and gradient so as to avoid channel degradation and/or aggradation. As discussed in greater detail in Section 3.6.1.1, many of the stream channels in the Moxa analysis area are very sensitive to disturbance pertaining to adverse channel morphology changes. Providing for adequate culvert or other channel crossing structure capacities and periodic inspection for structure competence and effectiveness would be particularly important to avoid important impacts on these sensitive streams. Crossing of perennial streams by linear facilities is unlikely as existing crossings would likely be utilized. If new crossings are proposed, location and construction of such crossings would need to be accomplished (i.e., siting, design, and construction) using best management practices that enable the activities to comply with the federal CWA, State Water Quality Act, and BLM administrative directives. Therefore, no significant impacts would likely occur in regard to surface water quantity due to construction of roads and pipelines across drainage channels.

The 500-foot buffer zone management directive would preclude siting of project facilities in the most flood-prone portions of floodplains. The general occurrence and distribution floodplains are shown in Exhibit 3-4. Areas beyond the 500-foot buffer zone would likely be subject to inundation at frequencies beyond the 100-year event. Therefore, facilities siting outside this buffer zone would not subject the facilities to hydrologic risk from flooding. However, these areas generally have relatively shallow water tables that could be readily polluted. Therefore, except where new roads and/or pipelines must cross, all project facilities should be kept out of the floodplain areas shown in Exhibit 3-4.

Most of the ephemeral drainage channels and all intermittent and perennial channels identified previously are classified as waters of the U.S. and are often associated with jurisdictional wetlands. Crossings of these channels would require authorization from the U.S. Army Corps of Engineers (COE) through the CWA Section 404 permitting process. However, these channel crossings would likely receive expedited authorization from the COE through Nationwide Permit No. 12 (buried utility lines) and/or No. 14 (minor road crossing fills). Each individual channel crossing would be reviewed during the APD/ROW permitting process for potential adverse impacts on water resources.

Jurisdictional wetlands are discussed in greater detail in the Vegetation Section 4.8 and are shown in Exhibits 3-4 and 3-5.

As discussed in Table 4-7, approximately 227,210 t/yr of soil erosion could occur from soil disturbances in the first year without erosion control or 71,923 t/yr with erosion control. These estimates assume all project facilities are constructed in the first year and are for total soil detached and entrained in place and do not include sediment transport over the ground surface. The vast majority of the soil detached and entrained is transported and deposited in very close proximity to the source and very little sediment is transported successfully to stream channels (over 500 feet per RMP directives). The primary factors of sediment delivery efficiency include slope gradient, roughness of soil and vegetation, and over reserve pit of transport. Most drainage channels occur in valley bottom locations with sideslope gradients less than ten percent. Undisturbed vegetation is relatively dense ranging from 50 to 80 percent in these areas. As indicated, the vast majority of soil disturbance is well away from stream channels. Given these conditions, sediment delivery efficiency is likely to be well below ten percent. Using this efficiency (i.e., ten percent), approximately 22,721 t/yr without erosion control and 7,192 t/yr with erosion control could be transported to stream channels in the first year. These sediment delivery values would be an increase in sediment yield in streams of approximately 0.01 ac-ft/mi^2/yr as compared to the BLM's current sediment yield estimate of 0.28 ac-ft/mi^2/yr. As discussed in Chapter 3, most sediment yield originates from channel erosion and degradation due to infrequent, high-intensity thunderstorm events. Therefore, significant increases in sediment input into streams would be unlikely with implementation of the proposed project.

For the same reasons described above, minimal leaching of salts from disturbed saline/sodic soils and subsequent minimal translocation of salt loading to streams would occur as a result of the proposed project. This increased salt loading would be minimal compared to the salts that naturally accumulate through evaporation in the ephemeral and intermittent channels. Minimal salt leaching is due to the small quantities of sediment that are transported to streams and the minimal increase in surface runoff as well as the distant location of most of the project facilities from stream channels. Therefore, no significant increase in salt loading is expected within the Moxa analysis area nor further downstream in Blacks Fork or into the Green River and below within the Colorado River.

The above analysis is for general sediment loading from overall soil disturbance. There is a chance that certain surface runoff, erosion, and sediment control measures could be ineffectually applied or ineffective in function for a variety of reasons. This could result in a large increase in sediment loading at a point source, but overall would have a negligible effect on overall sediment yield increase. Thus, significant increases in sediment delivery to streams and the sediment yield of streams in the analysis area are not likely to occur with project implementation.

Water would be required during the construction phase for road and drill-site construction, well drilling, well completion, and hydrostatic testing of pipelines. The source, amount, and/or timing of water use has not been specifically identified by the Operators. Approximate water usage for project construction could be as high as 1,000 gallons per acre of disturbance. This would equate to approximately 62 ac-ft of water for the 20,293 acres of disturbance. Water would also be used for hydrostatic testing of pipelines. Most of the pipelines would be four inches in diameter. As indicated in Chapter 2, approximately 1,458 miles of new pipeline would be constructed and hydrostatically tested. Assuming all pipelines would be tested at once and therefore water would not be re-used, approximately 12 ac-ft of water would be required for hydrostatic testing. Well drilling would require approximately 420,000 gallons or 1.3 ac-ft of water per well for a total of 1,723 ac-ft for all proposed drilling (1,325 wells). Well completion and testing would require approximately 105,000 gallons per well or 0.3 ac-ft per well for a total of 398 ac-ft of water. Therefore, the total maximum water usage required for the project during all phases (i.e., construction, testing, and production) without water re-use would be approximately 2,195 ac-ft over the ten-year planning period or 220 ac-ft/yr. Because of the difficult logistics of water management (i.e., location of water needs) and timing of water use, the re-use of water would not substantially reduce water requirements at any given time.

Handling and management of hydrostatic test water would need to be accomplished in a manner that does not adversely affect soils, streams channels, and surface water and groundwater quality. Used water from hydrostatic testing has relatively good water quality. A large portion of the hydrostatic test water would be re-used for other aspects of the construction, drilling, completion, and/or production processes. However, if such water is not re-used it must be disposed of in a manner where soil scouring and water quality impairment would not result.

As discussed in Chapter 2, water conservation and the re-use of water would be practiced by the Operators where feasible. Therefore, the actual quantity of water used by the Proposed Action could be less than 2,195 ac-ft. Water for use in project construction would be obtained from several potential sources including: 1) existing water wells within the Moxa analysis area, 2) from water wells drilled on the well pads, and 3) surface water diverted or pumped from perennial and intermittent streams. All water used for project construction would be obtained from State of Wyoming approved water sources according to legal water rights.

Withdrawal of surface water from perennial and intermittent streams to meet project demand would occur sporadically over the ten-year development period. Assuming 133 wells would be drilled and completed per year, 220 ac-ft of water would be required each year for project construction and well drilling, testing, and completion. Assuming constant withdrawal from a surface water source, the rate of withdrawal would be 0.3 cubic feet per second (cfs). Constant withdrawal would likely not occur but rather there would be periods of greater rates of withdrawal. Assuming withdrawal rates were ten times the constant rate, approximately three cfs would likely be the maximum rate of simultaneous withdrawal. Such a withdrawal rate could substantially reduce the flow of smaller streams and/or larger streams during baseflow periods. Therefore, should surface water be utilized to meet project water demand, careful planning should be implemented to ensure only minimum streamflow reduction occurs.

Any consumptive surface water use requires evaluation pursuant to the "Windy Gap Decision". According to the "Windy Gap Decision" of the FWS, any cumulative depletion in flow to the upper basin is considered to have a possible effect on the survival and recovery of these endangered species of fish. Although the flows of many tributaries in the upper basins have been modified, flow in the mainstem Green River is controlled by the Flaming Gorge Reservoir, and the resultant impacts on fish habitat are difficult to access. Therefore, the "Windy Gap Process" was developed to facilitate the calculation of flow depletions on a cumulative basis and the assessment of user fees to promote recovery of these species through monitoring research, habitat manipulation, and fish culture. The Operators may be required to pay a fee for any surface water consumptively used for the proposed project as discussed in the Special Status Species Section 4.10.

In regard to utilizing a groundwater source, the depth of most of the wells that could serve as a source of water ranges from 1,500 feet to over 8,000 feet. Most domestic and/or livestock wells have been completed at shallower depths, from 100 to 1,000 feet deep. Therefore, most extraction of groundwater for project construction would utilize different depths of groundwater and would not adversely affect domestic and livestock wells. However, should water be extracted from alluvial aquifers, there would be a greater probability of short-term adverse effect on other groundwater users. Unless all groundwater is obtained from shallow alluvial aquifers, reduction of streamflow in streams fed by shallow alluvial aquifers would likely not occur.

Reserve pits located on each drill pad would be utilized to contain drilling cuttings as well as waste water from the well drilling operations. As indicated in Chapter 2, all reserve pits would be unlined unless demonstrated they need to be lined based on site-specific conditions during the APD approval process. Bentonite or other synthetic impermeable liners that meet specific competency standards identified in Chapter 2 would be used where appropriate as defined in the APD process. Factors considered in determining the need for lining would depend on the character of earth material the pits are constructed in (e.g., soil permeability, stability, etc.) and their distance to sensitive environments. Situations where a liner may be required include a pit location within 50 feet of natural groundwater (as determined by drilling a pilot hole); when a well pad is located within the zone of potential impact to a perennial stream, lake, or reservoir; or the location is near a floodplain. Otherwise, an operator may use one outside of these areas. In general, pits should be lined in shallow water table areas; groundwater recharge areas; areas with drill sites within 500 feet of stream channels, seeps, springs, and/or internally drained lakes; and/or where reserve pits are constructed in earthen fill (as opposed to cut). BLM policy rarely allows reserve pits to be constructed in fill. Impermeable membrane material between 12 to 16 mils thick would be used to line a reserve pit. Leakage of pit fluids would be minimal from lined reserve pits unless the liners were installed incorrectly or the liners were damaged during drilling operations. Thus, adverse impacts from leaks in lined reserve pits would likely not occur.

Unlined pits would be used where fresh water based mud systems are used during drilling. Where used, unlined pits would be constructed in cut areas of a drill pad. Due to soil permeability problems, even lined pits, with perhaps rare exception, would be constructed only in cut areas also (as opposed to fill per BLM policy). The specific character of the cut material and its suitability for siting a reserve pit would be assessed prior to pit construction. Such material would be relatively tight with low infiltration and permeability rates. The potential for adverse impacts on surface water and groundwater quality would be greater for unlined pits as compared to lined pits. However, significant impacts on water quality resulting from leakage from unlined pits would be unlikely given the restrictions regarding when or where such pits would be used.

Well drilling and completion may adversely affect groundwater quality if mixing of water from different aquifers occurs. Deeper groundwater usually occurs under confined conditions. If a confined aquifer is penetrated, vertical (up or down) migration of groundwater may occur resulting in mixing of water of differing qualities. This mixing may result in a reduction in water quality. The magnitude of mixing is relatively small during drilling due to the relatively short period of time in which drilling is accomplished. In general, the upper 1,500 feet of the well is cased and cemented during the drilling process and this zone remains cased and cemented during the production phase. Therefore, the opportunity for significant degradation of groundwater quality in the upper aquifers is low.

Well completion must be accomplished in compliance with "Onshore Oil and Gas Order No. 2." These guidelines (USDI-BLM 1989) specify the following:

> *. . . proposed casing and cementing programs shall be conducted as approved to protect and/or isolate all usable water zones, potentially productive zones, lost circulation zones, abnormally pressured zones, and any prospectively valuable deposits of minerals. Any isolating medium other than cement shall receive approval prior to use.*

Usable water is defined as groundwater with a total dissolved solids (TDS) content of 10,000 parts per million (ppm) or less encountered at any depth. To comply with the order, wells must be completed in a manner by which either usable water is isolated from "unusable" water, or such that unusable water is isolated from usable water through the use of cementing and other proven technologies. Depending on the location of each well, most of the aquifers below 1,500 feet contain groundwater in excess of 10,000 TDS; however, some aquifer units contain usable water below 1,500 feet (see Water Resources Section 3.6.2 of Chapter 3). Therefore, cementing below 1,500 feet may be necessary to comply with the order. With well completion in compliance with the order, no significant impacts on groundwater quality would occur due to project implementation.

Corrosion of well casing has recently been identified as a problem resulting in mixing groundwater of various quality. Cathodic corrosion inhibitors are being utilized by several Operators to reduce such corrosion and subsequent leakage and mixing of groundwater. Similar protection devices or measures would be applied in this proposed project to protect groundwater quality and the integrity of the producing well.

The recent BLM policy identified in Section 2.2.3.1 that address well completion and casing to protect groundwater quality and prevent migration of natural gas into trona mines would further reduce the potential for significant adverse impacts on groundwater.

4.6.3.2 Alternative A

Potential impacts described under the Proposed Action also apply to Alternative A as well. Soils Section 4.5.3.2 describes the acres of impacts expected. The potential for such impacts under this alternative is likewise low, given stipulations and management actions incorporated into the proposal (Chapter 2).

Under this alternative, approximately 136,340 t/yr and 43,161 t/yr of erosion could occur with and without effective erosion control, respectively. With an approximate ten percent transport efficiency, total off-site sedimentation would be approximately 13,634 t/yr and 4,316 t/yr with and without effective erosion control, respectively. These sediment delivery values would be an increase in sediment yield in streams of approximately 0.01 ac-ft/mi^2/yr as compared to the BLM's current sediment yield estimate of 0.28 ac-ft/mi^2/yr. As discussed in Chapter 3, most sediment yield originates from channel erosion and degradation due to infrequent high intensity thunderstorm events. Therefore, significant increases in sediment input into streams are expected to be unlikely under implementation of the proposed project.

Under this alternative, water use would be less than the Proposed Action. Water would be required during the construction phase for road and drill site construction, well drilling, well completion, and hydrostatic testing of pipelines. Proposed water use for road and drill site construction has not been identified by the Operators at this time. However, approximate water usage disturbance could be as high as 1,000 gallons per acre or approximately 37 ac-ft of water. Water would also be used for hydrostatic testing of pipelines, most of which would be four inches in diameter. As indicated in Chapter 2, approximately 875 miles of new pipeline would be required for this alternative. Assuming all pipelines would be tested at once, and that water would not be re-used, approximately seven ac-ft of water would be required. Well drilling would require approximately 420,000 gallons or 1.3 ac-ft of water per well for a total of 1,034 ac-ft for all proposed drilling. Well completion and testing would require approximately 105,000 gallons per well or 0.3 ac-ft per well for a total of 239 ac-ft of water. Therefore, the total maximum water usage required for this alternative without re-use of water would be approximately 1,317 ac-ft over the ten-year planning period, or 132 ac-ft per year. Based on these water requirements and the impact discussion presented under the Proposed Action, no significant impacts to water resources under this alternative are expected. However, this determination depends on the location and timing of surface water withdrawal and on whether alluvial aquifers would be utilized.

4.6.3.3 Alternative B - No Action

Under the No Action alternative, water resources would continue to be impacted as described above under the action alternatives as APDs are granted by the BLM pursuant to previous authorizations. Under this alternative, unquantified additional development on a case-by-case basis would continue beyond the existing level of development. The magnitude of this additional development would be dictated by the economics and demand for gas production, as well as environmental constraints based on previous authorizations. Total off-site sedimentation under the existing condition within the Moxa analysis area could be as high as 7,799 t/yr. Under this alternative, future development, granted on a case-by-case basis, would likely be similar to Alternative A in regard to magnitude with similar impact levels. The increase in erosion and sedimentation and water use due to additional development activity under this alternative would also be of similar magnitude as Alternative A. Therefore, significant impacts are not expected to occur with implementation of the No Action alternative.

4.6.4 Impacts Summary

Potential impacts that could occur due to project implementation include increased surface water runoff and off-site sedimentation due to soil disturbance; increased salt loading and water quality impairment of surface waters; changes in stream discharge due to project disturbance; changes in groundwater levels, quantity and quality; and channel morphology changes due to road and pipeline crossings.

Under the Proposed Action, the alternative with the greatest magnitude of development activity, no significant impacts on surface water or groundwater quality and quantity are expected to occur. The magnitude of non-significant adverse impacts as compared to the Proposed Action would decrease under Alternative A, and the No Action alternative, Alternative B. Implementation of the Proposed Action would require approximately 2,195 ac-ft of water over the ten-year planning period or 220 ac-ft/yr during the construction, completion, and production phases, while Alternative A would require 1,317 ac-ft or 132 ac-ft/yr.

4.6.5 Cumulative Impacts

Section 4.5.5 provides a background discussion and acres of impact for cumulative disturbance within the Moxa analysis area and within the CIA area.

Moxa Analysis Area. As summarized in Table 4-8, existing disturbance within the analysis area ranges from 0.2 percent of a hydrologic unit to 10.5 percent, with an average disturbance per hydrologic unit of approximately four percent. This indicates that existing disturbance is not uniformly distributed across the analysis area and reaches an important threshold of ten percent in some hydrologic units. Following reclamation, residual disturbance within specific hydrologic units ranges from less than 0.1 percent to 4.6 percent. Although residual disturbance is considerably less than total disturbance, these percentages of hydrologic units are still relatively high. The cumulative disturbances of 17,725 acres under the Proposed Action and 15,451 acres under Alternative A (with reclamation) would not significantly impact surface water and groundwater quantity and quality for the reasons discussed under Section 4.6.3.

Cumulative Impacts Area. On a hydrologic unit basis, the percent disturbance in the CIA area outside of the Moxa analysis area ranges from less than 0.1 percent to 8.6 percent. This indicates that existing disturbance in the CIA area outside Moxa is not uniformly distributed but does not exceed the ten percent significance threshold. Taking reclamation into account, residual disturbance within specific hydrologic units ranges from less than 0.1 percent to 3.7 percent. Although residual disturbance is considerably less than total disturbance, these percentages of hydrologic units as shown in Table 4-8 are still relatively high.

The cumulative disturbance under the Proposed Action (taking reclamation into consideration) would be 28,917 acres or 1.4 percent of the CIA area. Therefore, cumulative impacts to watersheds, in general, would not be significant. Cumulative impacts under Alternatives A and B would be similar to those described for the Proposed Action, although the magnitude of cumulative impacts would be reduced below the Proposed Action which would not result in significant impact.

No serious groundwater pollution problems have been detected in the CIA area; however, there is some recent indication that some groundwater contamination has occurred in the Granger area. Current oil and gas exploration and development activities must comply with federal and State environmental quality laws and, thus, serious water quality and quantity impacts are not expected on a cumulative scale. This is particularly true given Onshore Oil and Gas Order No. 2 and the recent BLM guidelines that direct well techniques that reduce the potential for groundwater contamination.

4.6.6 Mitigation Summary

No additional measures beyond stipulations presented in Chapter 2, management direction contained in the RMP, Appendix A, Appendix B, and addition mitigation strategies identified in the above analysis would be required to minimize adverse impacts to water resources to non-significant levels assuming that these measures are consistently applied over all portions of the analysis area. Although these measures would be applied on federal lands, such measures may not be consistently applied on private and State lands.

4.6.7 Residual Impacts

With full and successful implementation of measures outlined in Chapter 2, the above analysis, and the reclamation guidelines identified in Appendix B (as needed), no significant residual impacts to water resources would occur. However, if the identified measures are not consistently applied on private and State lands, the resultant impacts could be of greater magnitude than identified in this EIS.

4.7 FISHERIES

4.7.1 Introduction

The principal fisheries impacts likely to be associated with the Proposed Action and Alternatives include 1) increased stream sedimentation, 2) downstream water pollution from accidental discharge of toxic substances, and 3) water flow depletions from the Hams Fork, Blacks Fork, or Green River.

4.7.2 Resource Management Objectives and Impact Significance Criteria

4.7.2.1 Resource Management Objectives

The Kemmerer RMP (USDI-BLM 1986) prescribes the following management objectives and stipulations associated with fish and their affected habitats pertaining to this project:

General

- Fish and wildlife habitat will be evaluated on a case-by-case basis as part of overall project planning.

- The attainment of WGFD strategic plan population objectives for wildlife will not be jeopardized.

Riparian and Wetland Areas

- Management actions will be directed towards maintaining or improving riparian habitat conditions by minimizing the impacts from surface disturbing activities in or near the riparian zones.
- Authorizations for ... or road construction will be addressed on a site-specific basis and will take wildlife and riparian values into consideration.
- Management actions in riparian areas and wetlands will include measures to preserve, protect, and if necessary, restore natural functions.
- Stream improvement practices to improve riparian and wetland areas for fisheries habitat will be implemented.

Inventory and Monitoring

- Important wildlife habitat will be monitored to determine seasonal habitat use and to identify areas in need of habitat improvement. These areas include ... riparian areas, ... wetlands, threatened and endangered species habitat, and non-game habitat.

4.7.2.2 Impact Significance Criteria

Given the management objectives in the RMP (USDI-BLM 1986) and as itemized above, the following criteria were used to determine the importance of impacts to fisheries within the Moxa analysis area:

- The attainment of WGFD strategic plan population objectives for fisheries are jeopardized. Factors considered in the assessment of the whether or not these objectives are in jeopardy include:
    - Increased instream siltation that results in a long-term reduction in downstream fish populations.
    - Stream channelization, culvert and bridge installations, or dewatering alters fish habitat and results in a long-term reduction in fish populations.
    - Stream contamination from spills of wastes and accidental releases of toxic substances that result in a long-term reduction in downstream fish populations.
    - Uptake or discharge of water used for drilling and construction causing dewatering of fish waters or alteration of fish habitat resulting in long-term reduction in fish populations.
- Non-compliance with existing BLM, FWS, or WGFD management objectives for wildlife, or BLM wildlife stipulations for surface occupancy criteria on oil and gas developments;

Note: A long-term reduction in fish populations is defined as one of sufficient magnitude to preclude the WGFD from maintaining population objectives.

4.7.3 Direct and Indirect Impacts

4.7.3.1 Proposed Action

Although the intermittent tributary drainages in the Moxa analysis area do not support fish populations, construction and operation activities have the potential to deposit sediments and toxic substances into these stream courses during high water runoff that could affect downstream fish populations in the Hams Fork, Blacks Fork, and Green River.

Under this alternative, water needed for drilling and testing operations would be obtained from local water source wells and streams. At a minimum, an estimated 2,195 ac-ft would be withdrawn from the Hams Fork, Blacks Fork, and Green Rivers over a ten-year period or an average annual withdrawal of 220 ac-ft. This could impart a low-level, short-term impact to area fisheries due to changes in water level, increased erosion and sedimentation, and increase in turbidity levels. Many of these impacts could be avoided or lessened in severity by the implementation of mitigative measures described in Chapter 2.

4.7.3.2 Alternative A

Under this alterative, a minimum of approximately 1,317 ac-ft would be withdrawn from the Hams Fork, Blacks Fork and Green rivers as needed for drilling and testing operations over a ten-year period or an average annual withdrawal of 132 ac-ft. This represents a 40 percent reduction in the amount of water withdrawn over the Proposed Action.

The nature of low-level impacts to fisheries from Alternative A would be the same as those under the Proposed Action, except that the magnitude of impacts would be marginally lower under this alternative.

4.7.3.3 Alternative B - No Action

Under the No Action alternative, the proposed project would not be constructed. Adoption of the No Action alternative would result in the continued build-out of previously authorized actions and the potential for additional development on State and private lands as APDs are granted on a case-by case basis by the WOGCC. This alternative would have similar but reduced short- and long-term impacts associated with the implementation of either the Proposed Action or Alternative A.

4.7.4 Impacts Summary

Potential impacts to fisheries resources include the degradation of surface water quality, an increase in stream flow from surface runoff, and a decrease in stream flow from the consumption of groundwater. However, given the avoidance and mitigation measures described in Chapter 2 and further described in this document (Section 4.7.6), no significant impacts are expected. See Section 4.10 for impacts to special status fish species.

4.7.5 Cumulative Impacts

The magnitude and extent of present sources of water depletion along the Green River and its tributaries is currently undetermined. Therefore, the cumulative effect of the estimated 2,195 and 1,317 ac-ft (or an average annual depletion of 220 and 132 ac-ft, respectively) that would be withdrawn from local sources of water under the respective alternatives of the Proposed Action and Alternative A is unknown.

4.7.6 Mitigation Summary

No additional measures beyond those already presented in this section and in Chapter 2 of this analysis would be required. See Section 4.10.5 for mitigation for special status fish species.

4.7.7 Residual Impacts

With full implementation of the mitigation measures contained in this section and in Chapter 2, no adverse residual impacts to fisheries are expected.

4.8 VEGETATION AND WETLANDS

4.8.1 Introduction

Direct impacts would include the short-term loss of vegetation (modification of structure, species composition, and areal extent of cover types). Indirect adverse impacts would include the short-term and long-term increased potential for weed invasion, establishment, and expansion; exposure of soils to accelerated erosion; shifts in species composition and/or changes in vegetative density away from a more desirable condition (e.g., native communities); a loss of natural biodiversity; reduction of wildlife habitat; and changes in visual aesthetics.

4.8.2 Resource Management Objectives and Impact Significance Criteria

4.8.2.1 Resource Management Objectives

In addition to the objectives for Soils and Water Resources, the Kemmerer RMP (USDI-BLM 1986) prescribes seven management objectives and actions relative to vegetation and wetlands. These include providing for reclamation of disturbed areas not in use and minimizing impacts to riparian areas and are also listed in the Vegetation, Wetlands, and Special Status Plant Species Technical Report (ECOTONE 1995b). In addition, Executive Order (EO) 11987 restricts the use of non-native species in reclamation.

4.8.2.2 Impact Significance Criteria

The following criteria were used to determine the significance of construction and operation of the proposed project on vegetation resources within the analysis area. These criteria were developed based on management directives, professional judgement, involvement in other National Environmental Policy Act (NEPA) projects throughout the West, and State regulations (e.g., the Wyoming Noxious Weed Act).

- non-compliance with management directives for the KRA;
- removal of vegetation such that following reclamation, the disturbed area(s) would not have adequate cover (density) and species composition (diversity) to support pre-existing land uses, including wildlife habitat, within a period of five years for general vegetation types or within two years for riparian and wetland areas;
- unauthorized discharge of dredged and/or fill materials into or excavation of waters of the U.S., including special aquatic sites, wetlands, and other areas subject to regulation under the federal CWA, EO 11988 (floodplains) and EO 11990 (wetlands and riparian zones);
- reclamation is not accomplished in compliance with EO 11987 (reclamation);
- introduction and establishment of noxious or other undesirable weedy plants to the degree that such establishment results in listed weedy species occupying more than 20 percent of a specific vegetation type or hampering successful revegetation of desirable species in disturbed areas;
- removal or disturbance of special status plants (or habitat judged important for survival) to the extent that such impact would threaten the viability of the local population and/or induce an upgrade in the federal, State, or resource area status;
- cumulative removal of more than ten percent of any vegetation cover type within the cumulative impact area (i.e., watershed of the analysis area).

4.8.3 Direct and Indirect Impacts

4.8.3.1 Proposed Action

Vegetation removal and soil handling associated with the construction and installation of well pads, pipelines, access roads, and other facilities as outlined in Chapter 2 would affect vegetation resources both directly and indirectly. Direct impacts would include the short-term loss of vegetation (modification of structure, species composition, and areal extent of cover types). Indirect impacts would include the short-term and long-term increased potential for weed invasion, establishment, and expansion; exposure of soils to accelerated erosion; shifts in species composition and/or changes in vegetative density; reduction of wildlife habitat; and changes in visual aesthetics.

Construction of the Proposed Action would affect 20,293 acres. Assuming all locations are productive, this area of impact would be reduced (upon successful reclamation as defined in Appendix B) to 5,691 acres. The likelihood of impact is greatest for the mixed desert shrub cover type, which occupies 66 percent of the analysis area. Except for habitats occupied by sensitive species, clearing of upland cover types would not be significant because they are generally abundant and widely distributed throughout the region and/or have been previously impacted (e.g., urban land, disturbed land).

Construction activities, increased soil disturbance, and higher traffic volumes could spur the introduction and spread of undesirable and noxious weed species within the analysis area. Weeds often out-compete desirable species, rendering an area less productive as a source of forage for livestock and wildlife. Additionally, sites dominated by weeds often have a different visual character that may negatively contrast with surrounding undisturbed vegetation. However, with implementation of BMPs and proposed mitigation measures (see Section 2.2.4), no significant impacts are anticipated.

Potential impacts to waters of the U.S., including wetlands and other special aquatic sites, could include clearing, excavating, filling, and grading. Such impacts would reduce the area and functional values offered by an affected cover type. Specific project impacts on waters of the U.S. cannot be accurately assessed since facility locations have not been identified. However, waters of the U.S. comprise approximately one percent of the analysis area and their occurrence is not contiguous; therefore, based on the proportion of wetlands in the analysis area, approximately 223 acres of wetlands could potentially be affected. Given the 500-foot buffer zone restriction from perennial waters and the existence of major roads crossing the perennial drainages, the potential for wetland impacts of this magnitude would be highly unlikely. Further, with implementation of mitigation measures presented in Sections 2.2.4.2.5 and 2.2.4.2.8, as well as compliance with the RMP, the CWA, and EOs 11990 and 11989, no significant impacts are anticipated. Road and pipeline crossings would likely be authorized under COE Nationwide Permits 12 (pipelines) or 14 (roads). Compliance might involve compensatory mitigation for affected wetlands if such areas cannot be avoided. This topic is further addressed in Section 4.8.6.

Surface disturbing activities could directly and indirectly affect cushion plant areas within the mixed desert shrub or barren lands cover types by destroying individual plants or their habitat, increasing the amount of fugitive dust, and introducing weeds. As cushion plants often exploit harsh environments, areas with high potential for supporting cushion plant communities include cliffs, rocky talus slopes, windswept ridges and slopes, and badlands). Such areas comprise an estimated seven percent of the analysis area. With implementation of measures in Section 2.2.4.2.5, and compliance with RMP management directives, no significant impacts to plant communities of concern are anticipated under the Proposed Action.

4.8.3.2 Alternative A

Fewer construction impacts (a total of 12,179 acres) would occur to all cover types, including wetlands and other special aquatic sites, under Alternative A. Production phase impacts would total 3,417 acres upon successful reclamation. As with the Proposed Action, the amount and duration of such impacts would depend on the locations of the wells and access roads. However, the majority of this impact would occur in the mixed desert shrub cover type.

Direct and indirect impacts to waters of the U.S. and to plant communities of concern are not specifically known. However, given the lesser area of land that would be affected, impacts would be lower than for the Proposed Action. The stipulations prescribed in the RMP (USDI-BLM 1986) and measures committed to by the Moxa Operators (Chapter 2) would preclude significant impacts to vegetative resources for reasons identified previously (Section 4.8.3.1).

4.8.3.3 Alternative B - No Action

The existing analysis area is not pristine. Approximately 25,999 acres have been disturbed by housing, commercial facilities (including drill and well sites, compressor stations, and processing plants), roads, pipelines, railroads, etc. A rough breakdown of the vegetation cover types in which this impact occurred is as follows: 169 acres of wetlands, 525 acres of agricultural land, 718 acres of barren lands, 3,076 acres of alkali scrub, 3,097 acres of vegetated sand dunes, and 18,414 acres of mixed desert shrub. At present, approximately 13,965 acres of this 25,999 acres are in various stages of revegetation.

Under the No Action alternative, vegetation would continue to be impacted as APDs are granted by the BLM for previously authorized activities and by the WOGCC for development on State and private lands. Loss of upland cover types likely would be proportional to their abundance in the analysis area but impacts are not anticipated to be significant as the number of wells placed would likely be less than under the action alternatives. If present, impacts to wetlands would be assessed as done with the Proposed Action and Alternative A and also mitigated on a case-by-case basis. Since many of the special status plant species discussed in Section 3.10 occur in cushion plant communities, rare plant surveys will address impacts to communities of concern. Noxious weed programs would be implemented per stipulations in individual APDs.

4.8.4 Impacts Summary

Implementation of the Proposed Action and Alternative A would initially affect 20,293 acres and 12,179 acres of various vegetation cover types, respectively, during project construction. Impacts to cover types are expected to be greatest for the mixed desert shrub cover type due to avoidance of sensitive areas, which are typically associated with wetlands, barren lands, and agricultural lands. Successful reclamation efforts during the production phase would reduce impacts to 5,691 acres and 3,417 acres, respectively, for the Proposed Action and Alternative A.

Impacts to vegetation would include removal of cover types (potential to decrease diversity and density of desirable species) and the increased potential for noxious weed invasion and establishment. Associated effects of such loss on wildlife, visual resources, and land use are discussed under those headings.

A reduction in vegetation cover type density and diversity under construction of the Proposed Action could create significant impacts for the mixed desert shrub, vegetated sand dunes, alkali scrub, and agricultural lands cover types. With successful reclamation, however, impacts to the native plant communities are expected to be just below the ten percent threshold for alkali scrub and would be lower for all other cover types. As such, implementation of the Proposed Action should not produce significant effects. However, any additional disturbance, particularly in the alkali scrub cover type, would likely overstep the ten percent threshold and constitute a significant effect. (See the cumulative impacts section for a detailed discussion of impacts relative to existing disturbance in the Moxa analysis area and to projects within the context of the larger watershed area.)

Upon construction of Alternative A, significant impacts (i.e., greater than ten percent) would likely occur in the agricultural lands and alkali scrub cover types, with impacts to the mixed desert shrub being non-significant but on the ten percent threshold. With successful reclamation, impacts are expected to fall below the ten percent threshold for all cover types. As such, implementation of the Alternative A should not produce significant cumulative impacts.

Monitoring for invasion and establishment of weeds and prompt and aggressive remediation, as provided for in Chapter 2, would prevent further weed invasion/establishment problems and facilitate successful revegetation of disturbed areas.

Project implementation could potentially impact the area and functions of wetlands, special aquatic sites, and other waters of the U.S. Direct impacts could occur through filling, grading, and excavation; indirect impacts could occur through hydrologic modification, sedimentation, pollution, and disturbance. Due to the larger area of disturbance associated with road and pipeline ROW facilities, the Proposed Action would be more likely to affect waters of the U.S. than Alternatives A or B. However, measures imposed by the RMP (USDI-BLM 1986) and the 404 permitting process--including site-specific surveys and mapping--would minimize/avoid impacts to jurisdictional wetlands and other special aquatic sites. As such, no significant impacts are anticipated for any alternative.

All alternatives have the potential to affect plant communities of concern. However, given implementation of Chapter 2 mitigation, compliance with the RMP, the BLM's Wyoming Policy on Reclamation (USDI-BLM 1990), and measures identified for Vegetation, Soils, Water Resources, and Visual Resources in this chapter, no significant impacts are anticipated. See Section 4.10 for a discussion on potential impacts to individual special status plant species and their habitat.

The duration and magnitude of impacts to vegetation cover types would depend on the locations of well sites and access roads, the success of mitigation and revegetation efforts, and the time needed for natural succession to return revegetated areas to predisturbance conditions. The latter may be on the order of 30 years for the mixed desert shrub community type. Revegetation success depends on the amount and quality of topsoil salvaged, stockpiled, and respread over disturbed areas as well as on weed control efforts.

Reclamation would be accomplished according to a site-specific reclamation and revegetation plan that uses BMPs. Revegetation would involve the use of native plant materials that meet specific reclamation objectives in terms of soil erosion control; soil protection, stabilization, and fertilization; aesthetics; and compatibility with native vegetation adjacent to the disturbance area. In spite of the poor reclamation potential for many soils, technology exists to return disturbed areas to predisturbance conditions in the time frame indicated by the significance criteria. Companies that create disturbances would not be released from reclamation bond responsibilities until adequate reclamation is completed.

4.8.5 Cumulative Impacts

4.8.5.1 Moxa Analysis Area

As discussed in Section 2.6.2, existing disturbances affect 25,999 acres (5.5 percent of 476,261 acres), of which 13,965 acres are in various stages of revegetation and the balance, 12,034 acres, is occupied by residences, businesses, transportation facilities, drill/well sites, production facilities, etc.

General Vegetation. During the construction phase, the Proposed Action would add 20,293 acres of impact for a cumulative area of 46,292 acres. Assuming disturbances would be proportional to the cover type occurrence, 14,002 acres of additional **mix desert shrub** vegetation would be affected for a total of 32,416 acres. Cumulative impacts would therefore represent ten percent of the total area occupied by the mixed desert shrub cover type. With successful production phase reclamation, impacts would be reduced to seven percent. For the **vegetated sand dunes** cover type, construction would increase impacts by 2,639 acres for a total of 5,736 acres or ten percent of the total area occupied by that cover type. With successful reclamation, impacts would be reduced to seven percent of the total area occupied by vegetated sand dunes. Impacts to **alkali scrub** would increase by 1,928 acres to a total of 5,004 acres or 12 percent of the total cover type. With successful reclamation, this impact would be reduced to nine percent. The Proposed Action would increase impacts to **barren land** by 1,278 acres, for a total of seven percent of that cover type (1,996 acres); however, with successful reclamation, impacts could be reduced to four percent. On **agricultural lands**, there would be an increase of 223 acres, for a total of 748 acres, or 13 percent of the total cover type. Upon successful reclamation, this impact would be reduced to ten percent. The **wetlands** cover type would receive 223 acres of impact, for a total of 392 acres under the construction phase (seven percent). Successful reclamation would reduce that amount to four percent of the area occupied by that cover type.

Impacts, however, are not likely to be exactly proportional to the areas occupied by the various cover types. Minimization and avoidance to areas with sensitive soils would effectively shift some of the impacts from barren lands, agricultural lands, wetlands, and steep slope areas (which primarily in the mixed desert shrub cover type) to the non-sensitive areas of the mixed desert shrub cover type as well as areas of vegetated sand dunes and alkali scrub.

Based on the criteria identified at the beginning of this section and assuming a partial shift of impacts from barren lands, agricultural lands, and wetlands to non-sensitive soils, significant impacts (i.e., greater than ten percent) would likely occur during the construction phase in the mixed desert shrub, vegetated sand dunes, alkali scrub, and agricultural lands cover types upon construction. With successful production phase reclamation, however, impacts are expected to be approaching the ten percent threshold for alkali scrub and to fall below that threshold for all other cover types. As such, implementation of the Proposed Action should not produce significant cumulative impacts. However, any additional disturbance, particularly in the alkali scrub cover type, would likely overstep the ten percent threshold and constitute a significant effect.

Alternative A would increase existing disturbance by 12,179 acres to 38,178 acres. Assuming disturbances would be proportional to the cover type occurrence, 8,464 acres of additional **mix desert shrub** vegetation would be affected for a total of 26,878 acres. Cumulative impacts would therefore represent nine percent of the total area occupied by this cover type. With successful production phase reclamation, impacts would be reduced to seven percent. For the **vegetated sand dunes** cover type, construction would increase impacts by 1,535 acres for a total of 4,632 acres or eight percent of the total area occupied by that cover type. With successful reclamation, impacts would be reduced to six percent of the total area occupied by vegetated sand dunes. Impacts to **alkali scrub** would increase by 1,157 acres to a total of 4,233 acres or ten percent of the total cover type. With successful reclamation, this impact would be reduced to eight percent. Alternative A would increase impacts to **barren land** by 767 acres, for a total of five percent (1,485 acres) of that cover type; however, with successful reclamation, impacts could be reduced to three percent. On **agricultural lands**, there would be an increase of 128 acres, for a total of 653 acres, or 12 percent of the total cover type. Upon successful reclamation, this impact would be reduced to ten percent. The **wetlands** cover type would gain 128 acres of impact, for a total of 297 acres under the construction phase (six percent). Successful reclamation would reduce that amount to four percent of the area occupied by that cover type.

As with the Proposed Action, impacts under Alternative A are not truly expected to be proportional to cover type occurrence because of shifts to avoid or minimize impacts to sensitive soils. Upon construction, significant impacts (i.e., greater than ten percent) would likely occur in the agricultural lands and alkali scrub cover types, with impacts to the mixed desert shrub being non-significant but on the ten percent threshold. With successful production phase reclamation, impacts are expected to be below the threshold for all cover types. As such, implementation of the Alternative A should not produce significant cumulative impacts. Because several of the cover type would be approaching the threshold for significance, careful consideration and evaluation of additional impacts from any other proposed activities within the analysis area should be considered.

Under the No Action alternative, additional surface disturbance would occur on a case-by-case basis. It is anticipated that such impact would be between five and seven percent of the analysis area. With regard to the various vegetation cover types, existing conditions indicate nine percent of the agricultural land has been affected, seven percent of alkali scrub, six percent of the mixed desert scrub, five percent of the vegetated sand dunes, three percent of wetlands, and two percent of the barren lands. With avoidance of sensitive soil areas and other sensitive resources (e.g., wetlands), impacts would likely be concentrated in areas of mixed desert scrub, vegetated sand dunes, and alkali scrub. Nevertheless, impacts would still fall below the ten percent threshold.

Wetlands. Any unpermitted impact to waters of the U.S. associated with this project or other projects in the vicinity or region would add to the cumulative loss of these important areas despite the impact being below the ten percent threshold. The historical loss of wetlands in the U.S. has been well documented as a major environmental problem. The total area of wetlands loss in the U.S. (lower 48 states) is not accurately known but is believed to exceed 90,000,000 acres--nearly half of the estimated original base. Of this total, 87 percent was due to agricultural conversion, eight percent due to urban development, and five percent due to other causes including mining and transportation (Dahl and Pywell 1989). Within Wyoming, there has been an approximate 38 percent loss of wetlands. With regard to the Moxa analysis area, application for a U.S. Army Corps of Engineers 404 permit and measures prescribed in Chapter 2 would remove the potential for significant cumulative impacts to these areas.

Plant Communities of Concern. No significant cumulative impacts would occur to plant communities of concern within the analysis area upon implementation of the proposed and recommended mitigation measures.

4.8.5.2 Cumulative Impacts Analysis Area

The Moxa analysis area represents approximately a quarter of the larger CIA area. Based on disturbances indicated on topographic maps, as modified from aerial photo data, there are 25,999 acres and 24,180 acres of existing disturbance within the Moxa analysis area and the watershed beyond, respectively. Such disturbances are due to roads, pipelines, railroads, mines, airstrips, towns, and other industry. The total existing disturbance is therefore approximately 2.5 percent of the CIA area. Assuming no reclamation for existing impacts, construction of the Proposed Action would increase the area of cumulative impacts to 70,472 acres (3.5 percent). Alternative A would affect a total of 62,358 acres (3.1 percent).

The assumption of no reclamation for existing impacts is invalid but provides a worst-case scenario. A more likely scenario is that areas of the existing disturbances would be reclaimed, reducing impacts to 12,034 acres for the existing disturbance in the analysis area and to 11,192 acres for existing impacts beyond the analysis area (assuming approximately 46 percent reclamation). Given these revised acres, the cumulative production phase impact under the Proposed Action would be 28,917 acres (1.4 percent) and 26,643 acres (1.3 percent) for Alternative A. As such, no significant impacts are anticipated for the CIA area.

4.8.6 Mitigation Summary

Mitigation measures committed to by the Moxa Operators (Chapter 2) include site-specific recommendations that would be developed by an interdisciplinary team (IDT) for all staked facilities; preparation of surface use plans; minimization of impacts due to clearing and soil handling; implementation of adequate erosion control measures; reseeding and site rehabilitation; noxious weed monitoring and control; compliance with Section 404(b)(1) guidelines of the federal CWA; and clearance surveys for plant communities of concern.

Pursuant to requirements of Section 404 of the CWA, maximum practicable avoidance of waters of the U.S. including special aquatic sites and jurisdictional wetlands and impact minimization would be required (see ECOTONE 1995b). Unavoidable adverse impacts to all special aquatic sites, including jurisdictional wetlands, would be mitigated. Most project components that involve discharge of dredged or fill material into or excavation of special aquatic sites would likely be authorized as separate and complete projects based on compensatory mitigation for the adverse effects. However, there is an opportunity to coordinate all mitigation requirements of adverse project impacts in the form of a "mitigation banking" effort. Such an effort would require substantial coordination of all proposed field activities and Operators with the COE and WDEQ. Mitigation banking could involve mitigation of all impacts in one large contiguous area that would provide increased overall ecological value, following the WDEQ's mitigation banking policy.

If noxious weeds are present in the predisturbance soil, vegetation removed from the ROW should not be respread over the disturbed soils. By way of clarification, weed monitoring should occur for species identified by the State of Wyoming as well as for additional species specified by each county during a given year. Such species comprise the official list of weeds for which a county may cost-share funding for control and removal efforts.

Per compliance with EO 11987, only native species would be used in revegetation efforts unless specifically authorized otherwise by the BLM. Where habitat for wildlife is crucial, replacement of wildlife-preferred species should be a priority. Use of exotics would be considered only for remedial revegetation and would require NEPA documentation to demonstrate that the species would not harm the natural ecosystem.

Only one additional measure is recommended (USDI-BLM 1979, 1982): To minimize total vegetative destruction and soil disturbance, construction of roads, drill pads, powerlines, pipelines and other facilities may be restricted between November 15 and March 15 as determined by the AO, depending on weather conditions.

There is a chance that some of the mitigation measures identified above would not be consistently applied over all lands. The Operators are not required to apply the same mitigation measures on State and private lands as on federal land. Therefore, the above mitigation may not be consistently applied to all areas of the proposed project, and project impacts may be greater in such areas.

4.8.7 Residual Impacts

No significant residual impacts to vegetation resources would occur with implementation of mitigation stipulations in the RMP and measures proposed by Moxa Operators although successful revegetation within three to five years would be difficult for some cover types. Revegetation to "predisturbance" conditions would require 30 years or more; however, this lag would not be significant provided substantial erosion or other significant environmental impacts do not occur during this long-term period.

Construction of the proposed project would involve clearing vegetation within the analysis area. Such loss of vegetation would be irretrievable. The loss could be partially reversible through revegetation of cut-and-fill slopes; however, some areas (e.g., destabilized sand dunes, steep slopes, badlands) may be particularly difficult to reclaim and could constitute an irreversible commitment of resources even with BMPs. Loss of plant communities of concern could also be an irreversible and irretrievable commitment of resources.

Potential impacts to waters of the U.S., including wetlands and other special aquatic sites, would be both reversible and retrievable through avoidance, impact minimization, and comprehensive compensatory mitigation that would ensure replacement of lost area and functional values of these sensitive cover types. If wetlands are impacted, the implementation of compensatory mitigation prior to project construction would reduce the potential for irretrievable impacts.

Although successful revegetation is feasible in the analysis area, there is a residual chance of ineffective application of revegetation measures. This would be particularly true on private and State lands where revegetation measures are not required as on federal lands.

4.9 WILDLIFE

4.9.1 Introduction

The principal wildlife impacts likely to be associated with the Proposed Action and alternatives include 1) the displacement of some wildlife species, 2) loss of certain wildlife habitats due to the development of drilling and production operations, 3) an increase in the potential for collisions between wildlife and motor vehicles, and

4) an increase in the potential for illegal kill and harassment of wildlife.

4.9.2 Resource Management Objectives and Impact Significance Criteria

4.9.2.1 Resource Management Objectives

The Kemmerer RMP (USDI-BLM 1986) prescribes the following management objectives and stipulations associated with fish, wildlife, and their affected habitats pertaining to this project:

General

- Fish and wildlife habitat will be evaluated on a case-by-case basis as part of overall project planning.
- The attainment of WGFD strategic plan population objectives for wildlife will not be jeopardized.
- Existing fences may be modified and new fences will be built to allow wildlife passage.
- Management actions will be directed towards maintaining or improving riparian habitat conditions by minimizing the impacts from surface disturbing activities in or near the riparian zones.
- Authorizations for ... road construction will be addressed on a site-specific basis and will take wildlife and riparian values into consideration.

Habitat Improvement

- Big game winter range will be improved using mechanical treatment, burning or other vegetation manipulation methods.
- Seasonal closures for motorized vehicles may be used to protect big game winter range.

Riparian and Wetland Areas

- Management actions in riparian areas and wetlands will include measures to preserve, protect, and if necessary, restore natural functions.
- Wetland areas will be improved for waterfowl production and sage grouse brood rearing areas.

Inventory and Monitoring

Important wildlife habitat will be monitored to determine seasonal habitat use and to identify areas in need of habitat improvement. These areas include big game winter ranges, riparian areas, sage grouse strutting and nesting areas, wetlands, threatened and endangered species habitat, and non-game habitat.

4.9.2.2 Impact Significance Criteria

Given the management objectives in the RMP (USDI-BLM 1986) and as itemized above, the following criteria were used to determine the importance of impacts to wildlife within the Moxa analysis area:

- The attainment of WGFD strategic plan population objectives for wildlife are jeopardized. Factors considered in the assessment of the whether or not these objectives are in jeopardy include:
    - The displacement of animals from crucial habitat during an important use period;
    - The permanent reduction in size, elimination, or otherwise rendering unsuitable for wildlife an officially designated crucial habitat;
    - Any effect, whether direct or indirect, that results in long-term decreases in recruitment and/or survival of individuals in a wildlife population; and/or
    - Disruption of grouse or raptor breeding or nesting activities.
    - A collective increase in direct mortality of wildlife due to road kill, poaching, harassment, or other causes,
- Non-compliance with existing BLM, FWS, or WGFD management objectives for wildlife, or BLM wildlife stipulations for surface

occupancy criteria on oil and gas developments.

4.9.3 Direct and Indirect Impacts

4.9.3.1 Proposed Action

Wildlife habitats would be affected by the project through direct physical disturbance by the construction of production wells, related roads, pipeline, and production facilities as well as through indirect disturbances in the zones of influence.

This alternative would provide an optimum development scenario of 1,325 production wells and related facilities over the ten-year planning period. This includes a total of 610 wells within the proven productive area (core area) of gas reserves and 715 wells from the flank area where production exists but reserves are not proven (see Exhibit 2-1). The current productive area is predominately spaced at four wells per section. The flank area is generally unspaced, but WOGCC rules allow drilling of four wells per section in the unspaced areas. The precise number of wells and their specific locations, however, would be directed by the success of developmental drilling and production technology, and economic considerations such as the cost of development of leases with marginal profitability. Since specific well site locations have not been designated, it is assumed for purposes of analysis in this EIS, that there is a uniform distribution of new well sites over the entire analysis area rather than specific designated well site locations. Thus, the analysis of impacts to wildlife for this alternative is based on an average density of 1.58 new well pads per section for the core area and 1.93 new well pads per section for the flank area with an associated disturbance of 15.31 acres per well.

Development at this level would disturb approximately 20,293 acres of wildlife habitat over the next ten-year planning period. This includes a total of 6,625 acres associated with well pad construction, 4,823 acres for access roads, 8,838 acres for pipeline construction, and seven acres for the construction of the compressor station. Beginning the first fall after wells start producing, these habitat alterations would diminish as vegetation becomes re-established along the pipeline and road ROWs and on the partial reclamation portions of active wells, and would continue with the subsequent reclamation of abandoned well sites that are no longer productive. Successful reclamation of well, road and pipeline construction activity would reduce the area disturbed by the Proposed Action to 5,691 acres. Grasses and forbs are expected to become established within the first several years following reclamation, however an estimated 15 to 20 years or more would be required for shrub establishment. Consequently, the removal of shrub habitat within the analysis area would represent a long-term loss to those species that depend on such vegetation for forage or shelter.

4.9.3.1.1 General Wildlife

The disturbance of 20,293 acres of wildlife habitat associated with the construction of production wells and related facilities would reduce habitat availability for a variety of common small birds and mammals. The major small nongame songbirds that would be lost or displaced by the reduction in habitat would be horned larks, sage sparrows, sage thrashers, and vesper sparrows. Although there is no way to accurately quantify these losses, this impact is likely to be moderately heavy in the short term. Because of the high reproductive potential of these species, they would rapidly repopulate reclaimed areas as habitats become suitable. Birds are highly mobile and would disperse into surrounding areas and utilize suitable habitats to the extent that they are available.

The principal small mammals found on the analysis area include, but are not limited to, deer mice, least chipmunks, Richardson's ground squirrels, white-tailed prairie dogs, desert cottontails, and white-tailed jackrabbits. The initial phases of surface disturbance would result in the direct mortality of many small burrowing mammals. Quantification of these losses is not possible because population data are lacking. While these losses could be moderately heavy, the high reproductive potential of these small mammals would enable populations to quickly repopulate the area once reclamation efforts are initiated.

The acreage disturbances to various wildlife habitats that could be expected to occur under the Proposed Action are summarized in Table 4-9.

4.9.3.1.2 Big Game

Pronghorn Antelope. Probably the most serious threat to the antelope population is from direct loss of crucial habitat as a result of surface disturbance associated with the initial installation and production of gas wells.

Table 4-9. **Developmental Parameters in Relation to Various Wildlife Habitats under the Proposed Action.**

Species	Habitat	Core Area		Flank Area		Totals		
		Size (ac)	No. Wells	Size (ac)	No. Wells	Area (ac)	No. Wells	Disturbance (ac)
Pronghorn Antelope	Winter/Yearlong Crucial	65,664	162	82,048	247	147,712	409	6,262
	Severe Winter Relief Crucial	6,592	17	11,712	35	18,304	52	790
	Winter/Yearlong	2,560	6	20,608	62	23,168	68	1,048
	Yearlong	24,320	60	46,080	139	70,400	199	3,047
Mule Deer	Winter/Yearlong	3,680	9	36,192	109	39,872	118	1,810
	Yearlong	12,544	31	4,800	14	17,344	45	696
Elk	Severe Winter Relief Crucial	20,800	51	16,320	49	37,120	101	1,540
Moose	Winter/Yearlong	160	0	3,680	11	3,840	11	176
	Yearlong	23,424	58	19,744	60	43,168	117	1,797
Prairie Dog	General (Colonies)	30,336	75	17,280	52	47,616	127	1,944
Sage Grouse	Breeding/Nesting	73,728	182	90,304	272	164,032	454	6,956

Approximately 260 square miles, or 35 percent of pronghorn habitat on the analysis area, is classified as crucial winter range. Assuming uniform distribution of proposed new wells over the analysis area, approximately 461 of the proposed 1,325 wells (35 percent) would be drilled within crucial antelope winter range (Exhibit 4-4). The development of these wells along with associated roads and pipelines would disturb an estimated 7,052 acres of the combined crucial winter and severe winter relief ranges within the analysis area. Reclamation efforts will proceed beginning the first fall after wells go on production and continue through the entire ten-year planning period. Such reclamation includes road ROW, pipelines, partial restoration of active well pads, and total restoration of abandoned well sites that are no longer productive. Under post-reclamation it is assumed that 30 percent of the disturbance is returned to productive antelope habitat in five years and the balance returned in 15 to 20 years (required for shrub reestablishment). Post-reclamation disturbance for the crucial winter range of the analysis area would be reduced to 4,935 acres on which on-going project activities would remain throughout the 30-year life of production. An additional 68 and 199 wells would be drilled within winter/yearlong and yearlong antelope habitats resulting in the disturbance of approximately 1,048 acres of winter/yearlong habitat and 3,047 acres of yearlong habitat for antelope.

West Green River - Over the ten-year planning period of the project approximately 226 of the proposed wells (17 percent) would be drilled within West Green River crucial winter range for antelope, resulting in the disturbance of 3,459 acres of crucial winter habitat (Exhibit 4-4). This represents 1.2 percent of the total available crucial winter range within the West Green River herd unit. After the first ten years of operation, post-reclamation efforts would have reduced disturbed acreage to approximately 2,421 acres on which on-going project activities would remain throughout the 30-year life of production.

Carter Lease - Over the ten-year planning period of the project an estimated 214 of the proposed 1,325 wells (16 percent) would be drilled within crucial antelope winter range in the Carter Lease herd unit (Exhibit 4-4). The development of these wells along with associated facilities would disturb approximately 3,278 acres of crucial habitat, or 1.4 percent of the total available crucial winter range within the Carter Lease herd unit. After the first ten years of operation, post-reclamation efforts would have reduced disturbed acreage to approximately 2,295 acres on which on-going project activities would remain throughout the 30-year life of production.

Uinta-Cedar Mountain - Over the ten-year planning period of the project approximately 21 of the proposed wells (two percent) would be drilled within crucial antelope winter range (Severe Winter Relief) in the Uinta-Cedar Mountain herd unit. (Exhibit 4-4). The development of these wells along with associated facilities would result in the disturbance of approximately 315 acres of crucial habitat, or 0.14 percent of the total available winter range within the Uinta-Cedar Mountain herd unit. After the first ten years of operation, post-reclamation efforts would have reduced disturbed acreage to approximately 219 acres on which on-going project activities would remain throughout the 30-year life of production.

As shown in Tables 4-12 and 4-13 in Section 4.9.5, the post-reclamation disturbance of an estimated 2,421, 2,295, and 219 acres of crucial winter range for these herd units would represent a 0.9, 1.0, and 0.1 percent loss in the crucial winter range within the West Green River, Carter Lease, and Uinta-Cedar Mountain herd units, respectively.

Antelope numbers were calculated by applying the herd unit objectives to the crucial winter range acreage for that herd to obtain density estimates of animals. With the implementation of the Proposed Action, the post-reclamation carrying capacity on the collective crucial winter ranges of the West Green River, Carter Lease, and Uinta-Cedar Mountain Antelope Herd Units would be reduced by 139 animals or by 0.6 percent of the overall population objectives for the three herd units (Table 4-13).

Since there are no accurate determinations of pronghorn carrying capacity within the Moxa analysis area it is not possible to accurately assess whether or not the 0.001 percent to 0.9 percent reductions of each herd unit crucial winter range carrying capacity will significantly affect WGFD's capacity to achieve its population objectives (e.g., the extent to which herd size is currently limited by winter forage availability is unknown). There may be enough forage left after the disturbance of vegetation by project activities to continue to support the WGFD's objectives, or there may not. If during the preparation of the Cooperative

Pronghorn/Livestock Mitigation and Habitat Loss Plan an accurate determination of pronghorn carrying capacity for the Moxa analysis area is made, habitat losses could be mitigated accordingly. At the very least, the losses of from 0.001 to 0.9 percent of crucial winter range are serious and would make the achievement of WGFD's objectives more difficult and challenging, and attempts to replace these losses should be made.

The re-establishment of crucial winter range will be an on-going process throughout the life of the well field and will, over time, replace lost acreage. All of the loss has been calculated up front, but will in fact take place over the first ten years of the project. Reclamation will also begin during the first year of the project and will extend at least up through the retirement of the last active well. The reduction in pronghorn carrying capacity initially created by project activities will be continuously diminished over the life of the project as shrub habitats on the area are restored through reclamation efforts.

By the end of the initial developmental activities during the first ten years of the project, on-going reclamation activities will have reduced the size of the disturbed area by approximately 30 percent, and shrub establishment on the initially reclaimed areas would have been achieved. At the end of the 30-year life of the well field, a well-developed mosaic of shrub stands would be present on an estimated 50 percent of the disturbed area and would be fully functional as pronghorn winter range. The development of the remaining 50 percent of the area into functional pronghorn winter range is likely to take an additional 15 to 20 years of post-reclamation time. Reclamation time may be shortened to eight to 15 years by supplemental planting of shrubs on undisturbed portions of the crucial winter range that currently support grassland types and by habitat manipulation involving the controlled burning or chaining of decadent shrub stands.

Mitigation of impacts could also include the implementation of multi-well single pad design. This type of design and setup would reduce the overall disturbance associated with individual well installation and production since multiple wells share a common access route, gathering, separation and storage system, and transportation facilities.

Mitigation of impacts should include those stipulations and measures incorporated into Chapter 2 and further described in this section. In order to mitigate the total amount of crucial winter pronghorn range that would be eliminated by construction and operation of the proposed wells within this habitat, Moxa Operators should participate in the Pronghorn and Livestock Mitigation Plan that is currently being developed to identify specific opportunities to reduce the impact of oil and gas development on pronghorn and livestock. This plan is being developed by the University of Wyoming FWS Cooperative Research Unit under contract with the BLM and the oversight committee (comprised of energy company contributors, private landowners, WGFD, and BLM).

In addition to the direct loss of habitat due to the development of wells and associated transportation facilities, disturbances from drilling activities and traffic would affect utilization of the habitat immediately adjacent to these areas. However, pronghorn have been found to habituate to increased traffic volumes (Reeve 1984) and heavy machinery as long as the machines move in a predictable manner, whereas deviation from the ordinary caused antelope displacement (Segerstrom 1982). The resident segment of the pronghorn population on the area has had many years of exposure and opportunity to adapt to oil and gas related activities and is unlikely to be significantly displaced by construction and drilling activities. However, as described in Chapter 3, approximately two-thirds of the collective pronghorn herd on the analysis area is migratory. Because these animals have not been continuously exposed to construction activities, their initial response to intensive construction activities could be avoidance and displacement. The magnitude of this response would decrease over time as 1) the animals have had more time to adjust to the circumstance and 2) the extent of the most intensive activities such as drilling and road building diminish and more wells are put into production. By the time the field is under full production, construction activities have ceased and traffic and human activities in general are greatly reduced, this impact would be minimal, and the level of pronghorn use of the area is likely to be determined mostly by the quality and quantity of forage available. Only long-term monitoring could determine the actual magnitude and duration of displacement and avoidance impacts.

Antelope are sensitive to disturbance at or near natal sites because does tend to isolate themselves about a week prior to fawning. Development in certain areas in

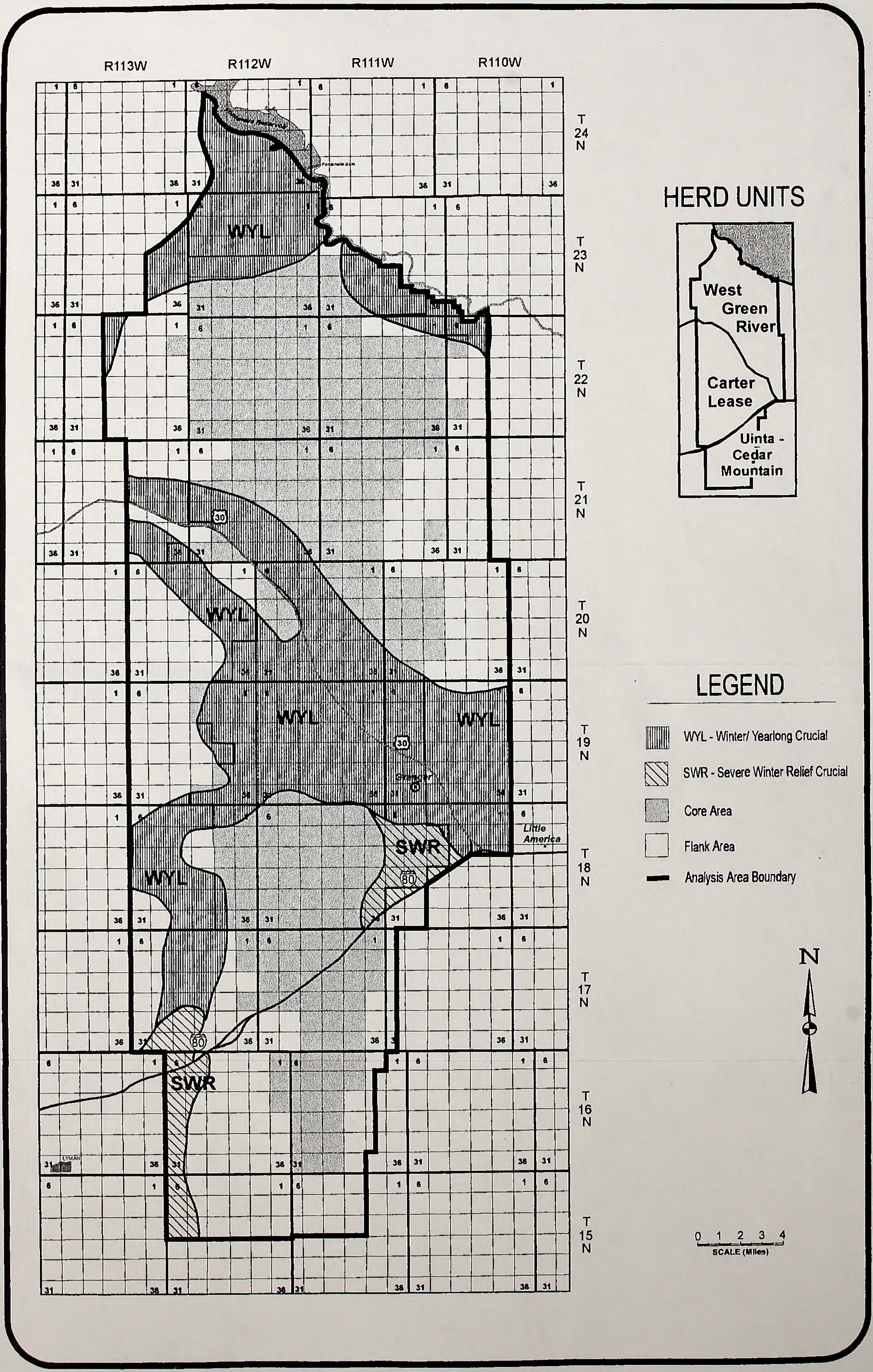

Exhibit 4-4. Crucial Habitat for Pronghorn Antelope Shown in Relation to the Current Production Area and Flank Area.

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the spring might, therefore, interrupt antelope fawning. Consequently, some reduction in local antelope reproduction could result; the degree would be dependent upon the amount of disturbance and the significance of the Moxa analysis area as a natal site.

The potential for vehicle collisions with pronghorn would increase as a result of increased vehicular traffic and speeds associated with the presence of construction crews and would continue (although at a reduced rate) throughout all phases of the well operations. Therefore, the potential for an increase in the incidence of pronghorn-vehicle encounters exists, and mitigative measures to avoid and/or reduce such incidents should be taken.

The short-term influx of temporary construction workers and the long-term increase in the use of the area by gas field employees would increase the potential for poaching and general harassment of antelope. Although such activities are not likely to reach significant proportions, it is possible, and steps to eliminate and/or minimize them should be taken. If hunting within the well field is prohibited (e.g., for safety reasons), the area could serve as a refuge during the hunting season and result in higher pronghorn densities in this area than is desired. If this happens, it may be necessary to apply special harvest measures described in the Mitigation Summary (Section 4.9.6).

Mule Deer. The analysis area supports a year-round resident population of mule deer. However, only 12 percent of the analysis area is classified as mule deer range, and of this area an estimated 39,872 acres are classified as winter/yearlong range for mule deer. There is no crucial range for deer in the analysis area.

Assuming uniform distribution of proposed new wells over the analysis area, an estimated 118 of the 1,325 wells (nine percent) would be drilled within mule deer winter/yearlong range. The development of these wells along with associated roads and pipelines would remove approximately 1,810 acres of winter/yearlong habitat within the analysis area. An additional 45 wells would be drilled within yearlong mule deer range and would remove an estimated 696 acres of habitat. The remainder of the proposed wells are not in designated mule deer range. Displacement of the deer from winter/yearlong range is not anticipated to result in a significant loss because of the relatively small area involved and the small number of deer using the area. For the same reasons, vehicle collision and poaching/harassment impacts to mule deer are expected to be minimal and non-significant.

White-tailed Deer. The small population of white-tailed deer that inhabits the analysis area is limited to the riparian/bottomland habitats along the Hams Fork River and, perhaps, the Blacks Fork. Because few if any of the proposed well locations fall within these habitats, impacts to this species are expected to be very minimal. Some potential for vehicle collisions exists where roads parallel or cross stream bottom habitats, and there is a small potential for impacts due to poaching and harassment. None of these impacts are expected to be significant.

Elk. Approximately eight percent of the analysis area is classified as elk range. The area totaling 37,120 acres is classified as severe winter relief habitat for elk. Assuming uniform distribution of new wells over the analysis area, an estimated 101 of the proposed 1,325 wells (eight percent) would be drilled within this habitat. Total well and associated road and pipeline construction would directly remove approximately 1,540 acres of severe winter relief range for elk during the ten-year planning period. This represents approximately 0.4 percent of the total severe winter relief and crucial winter range habitat available within the West Green River elk herd unit. The remainder of the proposed wells are not in designated elk range.

Elk use of severe winter relief habitat is considered equally important as crucial winter range--the primary difference being that use of and importance of severe winter relief range is limited to severe winters. With the onset of a severe winter, development at the proposed level within these areas would likely create a significant adverse effect on the local elk population. Such impacts could be avoided or mitigated by curtailing activities on severe winter relief range during crucial winter periods and by strategic placement of wells so as to avoid these areas to the greatest extent possible. Unless severe winters occur during the construction of wells and associated pipelines and roads, the project would not likely have any significant effect on elk populations. When or if severe winters occur, any surface activities within the severe winter relief range should be coordinated with the BLM and WGFD to determine what, if any, special condition restrictions are applicable (e.g., plowing big game "get off" gaps along the road and reduction in vehicle speeds). Due to the relative absence of elk from the analysis area, vehicle collision and poaching/harassment impacts to elk are expected to be minimal and insignificant as well.

Moose. Approximately 47,008 acres within the analysis area are classified as moose range and, of this area, only an estimated 3,840 acres are designated as winter/yearlong range for moose. There is no crucial range for moose on the analysis area.

Assuming uniform distribution of proposed new wells over the analysis area, only 11 of the proposed 1,325 wells (one percent) would be drilled within winter/yearlong moose habitat. Total well and associated road and pipeline construction would remove approximately 176 acres of winter/yearlong range for moose. An additional estimated 117 wells would be drilled within yearlong range, and together with associated pipelines and roads, would remove approximately 1,797 acres of moose habitat. The remainder of the proposed wells are not in designated moose range.

Moose occur primarily in riparian habitats within the analysis area, and proposed construction activity within riparian areas would be minimal. Proposed activities are not expected to have significant effects on moose populations in the area.

4.9.3.1.3 Sage Grouse

Assuming uniform distribution of proposed new wells over the analysis area, an estimated 454 wells would fall within yearlong sage grouse habitat (area within the two-mile radius surrounding the 38 known lek sites on the analysis area) and would physically remove an estimated 6,956 acres of habitat. Occupancy is restricted within a 0.25-mile radius from each lek from March 15 through May 31 to protect breeding habitat. This excludes 4,788 acres from occupancy for two and one half months out of the year (Exhibit 4-5). An additional 1.75-mile radius from each lek is protected from construction activities from March through mid-June to protect nesting habitat on a total of 159,244 acres (Exhibit 4-5). On the basis of current sage grouse use, time of season, presence/location of sagebrush cover, and topographic barriers, exceptions may be granted to these stipulations by the BLM AO on a case-by-case basis.

Although only four of the 38 historical leks were active in 1994, the activity status for the remaining leks is uncertain since surveys were initiated too late in the season to adequately assess their status. Consequently, most of the leks are assumed to be used by grouse, as BLM records indicate that nearly all of the leks identified within Moxa were active within the last five to six years and many were active as recently as one to three years ago. These leks have been monitored on alternate years by both BLM and WGFD personnel. Additional monitoring of leks will be performed by these agencies commencing in 1995.

The removal of 6,956 acres of habitat under this alternative would displace some grouse into adjacent areas of similar habitat and would reduce the carrying capacity of the area to support grouse for the life of the project, or until reclamation efforts have replaced the sagebrush habitats that were removed during construction. The application of BLM seasonal occupancy restrictions would result in the avoidance of impacts to breeding and nesting activities, and the implementation of a reclamation/habitat restoration plan would, over time, mitigate the long-term loss of sage grouse habitats.

4.9.3.1.4 Raptors

The primary potential impact to raptors from project activities is disturbance during nesting that might result in reproductive failure. This would be mitigated by prohibiting project activities within 0.25- to one-mile from active raptor nest sites from February 1 through July 31 (See Measure 7 in Section 2.2.4.2.9). The buffer radius and exclusion dates applicable would vary, depending upon activity status of nests, species involved, natural topographic barriers, and line-of-sight distances. Depending on the radius applied, from 126 to 2,010 acres per occupied nest may be protected from three to six months.

Based on aerial and ground surveys conducted in 1994 (HWA 1994), 21 active raptor nests (including burrowing owls) were identified within the analysis area (Exhibit 3-12). However, due to the early date of survey, many raptors had not yet commenced nesting activities and it is likely that some nests were activated after the survey date. Depending on the buffer radius used (0.25- to one-mile radius) on a minimum of 21 active nests, from 2,646 to 42,210 acres of the analysis area could be subject to seasonal restrictions. Exceptions

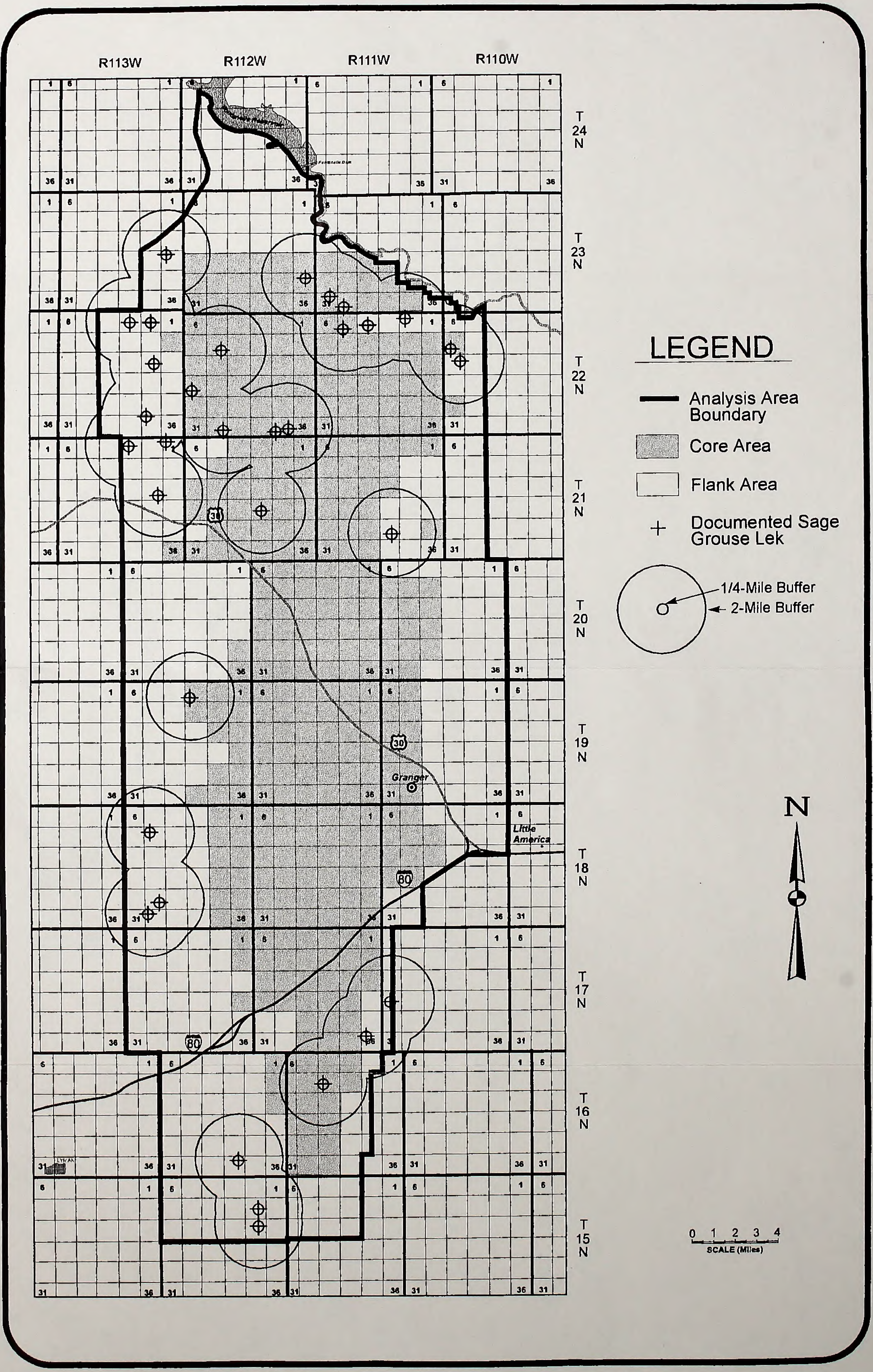

Exhibit 4-5. Seasonal Buffer Zones Associated with Documented Sage Grouse Leks Shown in Relation to the Proven Production Area and Flank Area.

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and modifications to these stipulations may be granted with approval from the BLM AO on a case-by-case basis.

Due to the temporary physical removal of various lagomorph, rodent, and bird habitats, a short-term reduction or dip in prey species availability is likely to occur following construction activities. Availability of prey species would soon be restored to original levels or higher as reclamation on pipelines, road corridors, and well pads occurs. Given the application of avoidance and mitigation measures presented in Section 2.2.4.2.9 and further described in this section, significant impacts to raptors are not expected.

4.9.3.2 Alternative A

This alternative would provide a minimum development scenario of 795 production wells and related facilities over the next ten-year planning period. This includes the same number of wells within the core area (610) as under the Proposed Action, but only 185 wells for the flank area as compared to 715 for the Proposed Action. The analysis of impacts to wildlife for this alternative is based on an average density of 1.58 well pads per section for the core area and 0.5 well pads per section for the flank area with an associated disturbance of 15.31 acres per well. Similar to the Proposed Action, this scenario is based on a uniform distribution of well sites over the entire analysis area rather than on specific designated well site locations, since specific well sites have not been designated.

Development at this level would result in the loss of approximately 12,179 acres of wildlife habitat over the next ten-year planning period. This includes a total of 3,975 acres associated with well pad construction, 2,894 acres for access roads, 5,303 acres for pipeline construction, and seven acres for the construction of the compressor station. Following initial reclamation efforts, disturbed acreage would be reduced to an estimated 3,417 acres on which on-going project activities remain throughout the 30-year life of production. Vegetation would become re-established along the pipeline ROW beginning the first fall after wells start producing and would continue with the subsequent reclamation of abandoned well sites that are no longer productive.

4.9.3.2.1 General Wildlife

The proposed disturbance of 12,179 acres of wildlife habitat associated with the construction of production wells under this alternative is 8,114 acres less than would be removed under the Proposed Action. Common small nongame songbirds and various species of small mammals are expected to be displaced by a reduction in available habitat. Although there is no way to accurately quantify these losses, this impact is likely to be moderately heavy in the short term. Because of the high reproductive potential of these species, they would rapidly repopulate reclaimed areas as habitats become suitable. Birds are highly mobile and would disperse into surrounding areas and utilize suitable habitats to the extent that they are available. The magnitude of this impact will be substantially less under this alternative than under the Proposed Action since 40 percent less habitat would be lost.

The acreage disturbances to various wildlife habitats that could be expected to occur under Alternative A are summarized in Table 4-10.

4.9.3.2.2 Big Game

Pronghorn Antelope. Alternative A encompasses the same pronghorn habitat on the analysis area as the Proposed Action but includes fewer wells. Assuming the uniform distribution of wells described for Alternative A, an estimated 252 of the proposed 795 wells (32 percent) would be drilled within crucial antelope winter range. The development of these wells along with associated facilities would disturb an estimated 3,863 acres of crucial winter range within the analysis area. Reclamation efforts will proceed beginning the first fall after wells go on production and continue through the entire ten-year planning period. Such reclamation includes road ROW, pipelines, partial restoration of active well pads, and total restoration of abandoned well sites that are no longer productive. Under post-reclamation, it is assumed that 30 percent of the disturbance is returned to productive antelope habitat in five years and the balance returned in 15 to 20 years (required for shrub reestablishment). Post-reclamation disturbance for the crucial winter range of the analysis area would be reduced to 2,703 acres. Another 22 and 96 wells would be drilled within winter/yearlong and yearlong antelope habitat resulting in the disturbance of approximately 343 acres of winter/yearlong habitat and 1,470 acres of yearlong habitat for antelope.

Table 4-10. Developmental Parameters in Relation to Various Wildlife Habitats under Alternative A.

Species	Habitat	Core Area		Flank Area		Totals		
		Size (ac)	No. Wells	Size (ac)	No. Wells	Area (ac)	No. Wells	Disturbance (ac)
Pronghorn Antelope	Winter/Yearlong Crucial	65,664	162	82,048	64	147,712	226	3,463
	Severe Winter Relief Crucial	6,592	17	11,712	9	18,304	26	400
	Winter/Yearlong	2,560	6	20,608	16	23,168	22	343
	Yearlong	24,320	60	46,080	36	70,400	96	1,470
Mule Deer	Winter/Yearlong	3,680	9	36,192	28	39,872	37	572
	Yearlong	12,544	31	4,800	4	17,344	35	532
Elk	Severe Winter Relief Crucial	20,800	51	16,320	13	37,120	64	981
Moose	Winter/Yearlong	160	0	3,680	3	3,840	3	50
	Yearlong	23,424	58	19,744	15	43,168	73	1,122
Prairie Dog	General (Colonies)	30,336	75	17,280	14	47,616	64	1,353
Sage Grouse	Breeding/Nesting	73,728	182	90,304	71	164,032	253	3,867

West Green River - Over the ten-year planning period of the project, approximately 108 of the proposed 795 wells (14 percent) would be drilled within crucial antelope winter range contained in the West Green River herd unit, resulting in the disturbance of approximately 1,652 acres of crucial winter habitat. This represents 0.6 percent of the total available crucial winter range within the West Green River herd unit. After the first ten years of operation, post-reclamation efforts would have reduced disturbed acreage to approximately 1,156 acres on which on-going project activities remain throughout the 30-year life of production.

Carter Lease - Over the ten-year planning period of the project, an estimated 138 of the 795 proposed wells (17 percent) would be drilled within Carter Lease crucial winter range for antelope. This would result in the disturbance of an additional 2,123 acres of crucial winter habitat, or 0.9 percent of the total available crucial winter range within the Carter Lease herd unit. After the first ten years of operation, post-reclamation efforts would have reduced disturbed acreage to approximately 1,486 acres on which on-going project activities remain throughout the 30-year life of production.

Uinta-Cedar Mountain - Over the ten-year planning period of the project, approximately six of the proposed 795 wells (one percent) would be drilled within crucial antelope winter range in the Uinta-Cedar Mountain herd unit resulting in the disturbance of approximately 88 acres of crucial habitat, or 0.04 percent of the total available winter range within the Uinta-Cedar Mountain herd unit. After the first ten years of operation, post-reclamation efforts would have reduced disturbed acreage to approximately 61 acres on which on-going project activities remain throughout the 30-year life of production.

Under Alternative A impacts from the direct loss of crucial habitat as a result of surface disturbance associated with the installation and production of gas wells would be less than under the Proposed Action. With the implementation of the Alternative A, the post-reclamation carrying capacity on the crucial winter ranges of the West Green River, Carter Lease, and Uinta-Cedar Mountain Antelope Herd Units would be reduced by 75 animals or by 0.3 percent of the overall population objectives for the three herd units (Table 4-13).

Since there are no accurate determinations of pronghorn carrying capacity within the Moxa analysis area it is not possible to accurately assess whether or not a 0.03 to 0.7 percent reduction in herd unit crucial winter range carrying capacity (Table 4-13) will significantly affect WGFD's capacity to achieve its population objectives (e.g., the extent to which herd size is currently limited by winter forage availability is unknown). There may be enough forage left after project removal of vegetation to continue to support the WGFD's objectives or there may not. If during the preparation of the Cooperative Pronghorn/Livestock Mitigation and Habitat Loss Plan an accurate determination of pronghorn carrying capacity for the Moxa analysis area is made, habitat losses could be mitigated accordingly. At the very least, the losses of from 0.03 to 0.7 percent of crucial winter range are serious and would make the achievement of WGFD objectives more difficult and challenging, and attempts to replace these losses should be made. Impact assessments and mitigation measures described for the Proposed Action are also applicable to Alternative A.

Analyses presented under the Proposed Action for potential impacts associated with the potential for vehicle collisions, poaching, displacement, and overpopulation of resident animals in the well field are equally applicable to Alternative A. However, there would be a proportionately lower potential for impacts under Alternative A because there are approximately 110 fewer miles of roads and 530 fewer wells than there are under the Proposed Action.

The short-term influx of temporary construction workers and the long-term increase in the use of the area by gas field employees would increase the potential for poaching and general harassment of antelope. Because of the reduced number of wells and associated miles of road and pipeline, the potential for impacts from this source under Alternative A is proportionately lower than under the Proposed Action. Although such activities are not likely to reach significant proportions, it is possible, and steps to eliminate and/or minimize them should be taken.

Mule Deer. Although mule deer occupy portions of Moxa year-round, most of the analysis area (88 percent) is not classified as mule deer range. Occupied habitat includes winter/yearlong and yearlong range for mule deer; there is no crucial range for deer on the analysis area.

Assuming the distribution of wells described for Alternative A, an estimated 37 of the proposed 795 wells (five percent) would be drilled within mule deer winter/yearlong range. The development of these wells along with associated roads and pipelines would remove approximately 572 acres of winter/yearlong habitat within the analysis area. An additional 35 wells would be drilled within yearlong mule deer range and would remove an estimated 532 acres of habitat. The remainder of the proposed wells are not in designated mule deer range. Displacement of the deer from winter/yearlong range is not anticipated to result in a significant loss because of the relatively small area involved and the small number of deer using the area. For the same reasons, vehicle collision and poaching/harassment impacts to mule deer are expected to be minimal and non-significant.

White-tailed Deer. Impacts would be the same as described for the Proposed Action.

Elk. Designated range for elk occurs on eight percent of the analysis area. This area totaling 37,120 acres is classified as severe winter relief habitat for elk and is considered equally important as crucial winter range. Assuming the distribution of wells described for Alternative A, an estimated 64 of the proposed 795 wells (eight percent) would be drilled within this habitat. Total well and associated road and pipeline construction would directly remove approximately 981 acres of severe winter relief range for elk during the ten-year planning period. This represents approximately 0.2 percent of the total available severe winter relief and crucial winter range within the Green River herd unit for elk. The remainder of the proposed wells are not in designated elk range.

Use of severe winter relief habitat by elk is limited almost exclusively to severe winters. Under normal winter weather, the construction of wells and associated pipelines and roads would not likely have any significant effect on elk populations. However, with the advent of severe winter weather, implementation of the Alternative A may create a significant adverse impact to elk that use the area. For the same reason described under the Proposed Action, mitigation measures would be necessary in the event of severe winter weather in order to reduce impacts to non-significant levels.

Moose. Approximately 47,008 acres within the analysis area are classified as moose range. Of this area, only an estimated 3,840 acres are designated as winter/yearlong range for moose. There is no crucial range for moose on the analysis area.

Assuming the distribution of wells described for Alternative A, it is estimated that only three of the proposed 795 wells (0.4 percent) would be drilled within winter/yearlong moose habitat, resulting in a loss of approximately 50 acres of winter/yearlong range for moose. An additional 73 wells would be drilled within yearlong range and, together with associated pipelines and roads, would remove approximately 1,122 acres of moose habitat. The remainder of the proposed wells are not in designated moose range. Because of the small amount and non-crucial nature of the habitat lost and the relatively low numbers of moose in the analysis area, the implementation of this alternative is not expected to have significant effects on the species.

4.9.3.2.3 Sage Grouse

Alternative A encompasses the same sage grouse breeding and nesting habitat on the analysis area as the Proposed Action but involves fewer wells. The proposed development of 253 wells within yearlong habitat for sage grouse would remove an estimated 3,867 acres of habitat associated with 38 documented leks located on the analysis area. Occupancy restrictions for active leks under this alternative would essentially be the same as described for the Proposed Action. The removal of 3,867 acres of habitat under this alternative would displace some grouse into adjacent areas of similar habitat and would reduce the carrying capacity of the area to support grouse for the life of the project, or until reclamation efforts have replaced the sagebrush habitats that were removed during construction. The application of BLM seasonal occupancy restrictions would result in the avoidance of impacts to breeding and nesting activities and the implementation of a reclamation/habitat restoration plan would, over time, mitigate the long-term loss of sage grouse habitats.

4.9.3.2.4 Raptors

As with the Proposed Action, the primary potential impact to raptors from project activities is disturbance during nesting that might result in reproductive failure. This would be mitigated by implementation of standard seasonal buffer restrictions around active raptor nests--the same as described for the Proposed Action. Depending on the radius applied, from 126 to 2,010 acres per occupied nest could be subject to seasonal restrictions from three to six months.

Due to the temporary physical removal of various lagomorph, rodent, and bird habitats, a short-term reduction or dip in prey species availability is likely to occur following construction activities. Availability of prey species would soon be restored to original levels, or higher, as reclamation on pipelines, road corridors, and well pads occurs. Given the application of avoidance and mitigation measures presented in Section 2.2.4.2.9 and further described in this section, significant impacts to raptors are not expected.

4.9.3.3 Alternative B - No Action

Under the No Action Alternative, the proposed project would not be constructed and further drilling would be allowed on federal lands only to the extent that it would be within the scope of the existing environmental analyses (USDI-BLM 1991a). However the WOGCC could approve new APDs on a case-by-case basis for State and private lands. Adoption of the No Action alternative would result in a lesser degree of short- and long-term impacts associated with the implementation of the Proposed Action and Alternative A. These impacts would consist mainly of hunters who travel existing roads, current and future authorized oil and gas production, and livestock grazing.

4.9.4 Impacts Summary

With the implementation of either the Proposed Action or Alternative A, direct loss of habitat would result from surface disturbance associated with the construction of well sites and related access roads and pipelines. In addition, some wildlife species would be indirectly impacted by displacement from habitats in the vicinity to the analysis area due to the presence of human activities associated with the construction and operation of wells. The potential for collisions between wildlife and motor vehicles would also increase due to the construction of new roads and increased traffic levels on existing roads. The severity of these impacts would be expected to decrease with the completion of the construction phase and with the onset of reclamation efforts on many of the disturbed areas.

The nature of impacts to wildlife is identical between the Proposed Action and Alternative A. The magnitude of potential impacts would be greater under the Proposed Action, however, because of the greater number of well sites and miles of associated access roads. Table 4-11 summarizes the amount of disturbance to wildlife habitat in a comparative format for the two alternatives considered. As seen on Table 4-11, the total disturbance associated with the core area is the same for both alternatives. The reduction in the total amount of habitat disturbed with Alternative A is attributed to the lower number of wells proposed for the flank area under this alternative. With the implementation of Alternative A, from 31 to 72 percent less wildlife habitat would be affected than with the Proposed Action.

The analyses of impacts and the reduction of impacts were based on the application of prescribed avoidance and mitigation measures to fee and State lands as well as BLM lands. Unless these measures are applied to all lands within the affected analysis area, long-term significant impacts may occur.

4.9.5 Cumulative Impacts

The analysis of cumulative impacts from the development of gas wells and associated facilities assumes a uniform distribution of well sites over the entire analysis area, based on existing WOGCC-approved spacing within individual fields. The rational behind this analysis is that actual well site locations have not been designated and assumptions cannot be made as to the precise number of wells per section, since specific well locations would be directed by the success of developmental drilling and production technology, economic considerations such as the cost of development of leases with marginal profitability, and topographic considerations.

Currently there are 957 drill/well sites within the Moxa analysis area. Wells account for 19 percent of existing disturbance; existing roads, pipelines, and facilities account for another 75 percent, and existing urban areas and railroads comprise the remainder.

The delineation of existing disturbances to the analysis area, as set forth in Section 2.6.2, describes the post-reclamation existing disturbance of 12,034 acres. Post-reclamation disturbance under the Proposed Action would add 5,691 acres over the long term and bring the cumulative disturbance within Moxa to 17,725 acres. Under Alternative A the amount of post-reclamation disturbance would add 3,417 acres to the existing

Table 4-11. **Comparison in Reduction of Wildlife Habitat between the Two Development Scenarios (numbers in acres).**

Species	Habitat	Proposed Action			Flank Area			Percent Difference[1]
		Core Area	Flank Area	Total	Core Area	Flank Area	Total	
Pronghorn Antelope	Winter/Yearlong Crucial	2,481	3,781	6,262	2,481	981	3,463	45
	Severe Winter Relief Crucial	245	545	790	245	155	400	51
	Winter/Yearlong	92	956	1,048	92	251	343	67
	Yearlong	919	2,128	3,047	919	551	1,470	52
Mule Deer	Winter/Yearlong	138	1,672	1,810	138	434	572	69
	Yearlong	475	221	696	475	57	532	24
Elk	Severe Winter Relief Crucial	781	759	1,540	781	200	981	36
Moose	Winter/Yearlong	6	170	176	6	44	50	72
	Yearlong	888	909	1,797	888	234	1,122	38
Prairie Dog	General (Colonies)	1,148	796	1,944	1,148	205	1,353	31
Sage Grouse	Breeding/Nesting	2,786	4,170	6,956	2,786	1,081	3,867	45

1 - Proportional difference in habitat loss between the Proposed Action and Alternative A.

disturbance, bringing the total cumulative post-reclamation disturbance to 15,451 acres.

4.9.5.1 Pronghorn Antelope Crucial Winter Range

Existing disturbance within crucial winter range habitat for antelope has reduced the total acreage of this habitat by approximately 1.7, 2.6, and 0.5 percent within the West Green River, Carter Lease, and Uinta-Cedar Mountain herd units, respectively (Table 4-12). This translates to a reduction in the carrying capacity of crucial winter range for antelope by approximately 132 animals for the West Green River herd unit, 156 animals for the Carter Lease herd unit, and 52 animals for the Uinta-Cedar Mountain herd unit (Table 4-13). For purposes of analysis in this EIS, carrying capacity reduction numbers were calculated by dividing the WGFD's population objective within each herd unit into the total acreage of crucial winter range within the respective herd unit. The resultant number (acres per animal) was then used as a density estimate of animals applied to the reduced carrying capacity within crucial winter range.

Under the Proposed Action, there would be an estimated 2,421, 2,295, and 219 acres of post-reclamation disturbance to crucial winter range within the West Green River, Carter Lease, and Uinta-Cedar Mountain herd units, respectively (Table 4-12). This represents a decrease in the carrying capacity for antelope within the respective herd units by 69, 60, and ten animals, respectively (Table 4-13). This would result in an additional reduction in approximately 0.9, 1.0, and 0.1 percent of crucial winter range within the respective herd units of West Green River, Carter Lease, and Uinta-Cedar Mountain and bring the cumulative totals to 2.5, 3.6, and 0.6 percent, respectively.

Under the Proposed Action, the post-reclamation carrying capacity on the cumulative crucial winter ranges of the West Green River, Carter Lease, and Uinta-Cedar Mountain Antelope Herd Units would be reduced by 139 animals and, together with the existing reduction in carrying capacity, of 340 animals, would increase the cumulative total to 479 animals, or two percent of overall population objectives for the three herd units (Table 4-13).

Under Alternative A, post-reclamation surface disturbance would involve an estimated 1,156, 1,486, and 61 acres of available antelope crucial winter range within the West Green River, Carter Lease, and Uinta-Cedar Mountain herd units, respectively (Table 4-12). Under this alternative, the carrying capacity for antelope would be reduced within the West Green River herd unit by 33 animals, the Carter Lease herd unit by 39 animals, and in the Uinta-Cedar Mountain herd unit by three animals.

The removal of crucial winter range from the West Green River, Carter Lease, and Uinta-Cedar Mountain herd units would represent a 0.4, 0.6, and 0.02 percent loss in the total available crucial winter range within the respective herd units and bring the cumulative total to 2.1, 3.2, and 0.6 percent within the West Green River, Carter Lease, and Uinta-Cedar Mountain herd units, respectively.

Under Alternative A, the post-reclamation carrying capacity on the cumulative crucial winter ranges of the West Green River, Carter Lease, and Uinta-Cedar Mountain Antelope Herd Units would be reduced by 75 animals and, together with the existing reduction in carrying capacity, of 340 animals, would increase the cumulative total to 415 animals, or 1.7 percent of overall population objectives for the three herd units (Table 4-13).

Since there are no accurate determinations of pronghorn carrying capacity within the Moxa analysis area it is not possible to accurately assess whether or not a two percent or 1.7 percent overall cumulative reduction in population objectives, Proposed Action and Alternative A, respectively, will significantly affect WGFD's capacity to achieve its population objectives (e.g., the extent to which herd size is currently limited by winter forage availability is unknown). There may be enough forage left after project removal of vegetation to continue to support the WGFD's objectives, or there may not. If during the preparation of the Cooperative Pronghorn/Livestock Mitigation and Habitat Loss Plan an accurate determination of pronghorn carrying capacity for the Moxa analysis area is made, habitat losses could be mitigated accordingly. At the very least, the cumulative losses on these herd unit crucial winter ranges of from 0.6 to 3.6 percent (Proposed Action) and 0.6 to 3.3 percent (Alternative A) are serious and would make the achievement of WGFD objectives more difficult and challenging, and attempts to replace these losses should be made.

Table 4-12. **Amount of Disturbance Associated with the Two Development Scenarios in Relation to Existing Levels within Crucial Winter Ranges for Antelope.**

Herd Unit	Disturbance Feature	Existing Disturbance (Acres)	Proposed Action			Alternative A		
			Proposed Disturbance (Acres)	Post Reclamation Disturbance (Acres)¹	Cumulative Acreage	Proposed Disturbance (Acres)	Post Reclamation Disturbance (Acres)¹	Cumulative Acreage
West Green River (278,912 acres)	Wells	656	1,130	791	1,447	536	375	1,031
	Roads	2,268	822	575	2,843	394	276	2,544
	Pipelines	--	1,507	1,055	1,055	722	505	505
	Facilities	14	--	--	14	--	--	14
	Railroads	1,160	--	--	1,160	--	--	1,160
	Other	512	--	--	512	--	--	512
	Total	**4,610**	**3,459**	**2,421**	**7,031**	**1,652**	**1,156**	**5,766**
	Percent of Total CWR	**1.7**		**0.9**	**2.5**		**0.4**	**2.1**
Carter Lease (228,480 acres)	Wells	776	1,070	749	1,525	690	483	1,259
	Roads	1,792	778	545	2,337	506	354	2,146
	Pipelines	--	1,423	996	996	920	644	644
	Facilities	22	7	5	27	7	5	27
	Railroads	2,693	--	--	2,693	--	--	2,693
	Other	629	--	--	629	--	--	629
	Total	**5,912**	**3,278**	**2,295**	**8,207**	**2,123**	**1,486**	**7,398**
	Percent of Total CWR	**2.6**		**1.0**	**3.6**		**0.6**	**3.2**

Table 4-12. Amount of Disturbance Associated with the Two Development Scenarios in Relation to Existing Levels within Crucial Winter Ranges for Antelope, Continued.

Herd Unit	Disturbance Feature	Existing Disturbance(Acres)	Proposed Action			Alternative A		
			Proposed Disturbance (Acres)	Post Reclamation Disturbance (Acres)[1]	Cumulative Disturbance	Proposed Disturbance (Acres)	Post Reclamation Disturbance (Acres)[1]	Cumulative Disturbance
Uinta-Cedar Mountain (225,280 acres)	Wells	--	105	72	72	29	20	20
	Roads	1,088	70	49	1,137	20	14	1,102
	Pipelines	--	140	98	98	49	27	27
	Facilities	7	--	--	7	--	--	7
	Railroads	84	--	--	24	--	--	24
	Other	84	--	--	84	--	--	84
	Total	1,203	315	219	1,422	88	61	1,264
	Percent of Total CWR	0.5		0.1	0.6		0.02	0.6

[1] - Assumes 30 percent return of disturbed area to productive antelope habitat with balance returned in eight to 15 years.

Table 4-13. **Reduction in Animal Carrying Capacity Based on the Amount of Disturbance Associated with the Two Development Scenarios in Relation to Existing Disturbance Levels within Crucial Winter Ranges for Antelope.**

Herd Unit	WGFD Population Objective	Acres Per Animal	Reduction in Animals							
			Existing Disturbance	Total Project Disturbance		Post-Reclamation[1]		Cumulative Post-Reclamation/ Percent of Objective	
				Proposed Action	Alternative A	Proposed Action	Alternative A	Proposed Action	Alternative A
West Green River (278,912 acres)	8,000	35	132	99	47	60	33	201	165
						0.9% Obj	0.04% Obj	2.5% Obj	2.0% Obj
Carter Lease (228,480 acres)	6,000	38	156	86	56	60	39	216	195
						0.01% Obj	0.7% Obj	3.6% Obj	3.3% Obj
Uinta-Cedar Mountain (225,280 acres)	10,000	23	52	14	4	10	3	62	55
						0.001% Obj	0.03% Obj	0.6% Obj	0.6% Obj
Total Units (732,672 acres)	24,000	31	340	199	107	139	75	479	415
			1.4% Obj			0.6% Obj	0.3% Obj	2.0% Obj	1.7% Obj

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[1] - Assumes 30 percent return of disturbed area to productive antelope habitat with balance returned in eight to 15 years.

At the end of the 30-year life of the well field, a well-developed mosaic of shrub stands would be present on an estimated 50 percent of the disturbed area and would be fully functional as pronghorn winter range. In the absence of supplemental planting, the development of the remaining 50 percent of the area into functional pronghorn winter range is likely to take an additional ten to 15 years of post reclamation time. Under either the Proposed Action or Alternative A, restoration of pronghorn crucial winter range losses to their pre-disturbance condition would take approximately 50 years. This restoration period could be shortened substantially by early supplemental planting of shrubs in grassland areas not scheduled for disturbance and by habitat manipulations such as prescribed burning or chaining of decadent shrub stands.

4.9.5.2 Elk

Existing disturbances within severe winter relief and crucial winter range habitat for elk has reduced the total acreage of these habitats by approximately 1,736 acres or 0.4 percent within the West Green River herd unit. Under the Proposed Action and Alternative A, an estimated 1,544 and 981 acres of severe winter relief range would be eliminated over the short-term within the West Green River herd unit. This would result in an additional reduction of approximately 0.4 and 0.2 percent, respectively, of severe winter relief and crucial winter ranges with the West Green River herd unit and bring the cumulative total to 0.8 percent under the Proposed Action and 0.6 percent under Alternative A. Impacts to elk under either alternative would be non-significant under normal winter conditions but could reach significant proportions with the onset of severe winter weather. These potential impacts would be offset by implementation of the prescribed mitigation measures presented in Section 4.9.6, Mitigation Summary.

4.9.5.3 Mule Deer, White-tailed Deer, and Moose

Mule deer, white-tailed deer, and moose occupy primarily riparian habitats within the analysis area. Existing and proposed disturbance within this habitat is minimal and there are no crucial ranges for these species within the analysis area. Therefore, neither of the action alternatives is likely to create impacts that would significantly affect mule deer, white-tailed deer, or moose populations.

4.9.5.4 Sage Grouse

Existing disturbance to potential yearlong sage grouse habitat has reduced the total acreage of this habitat by approximately 1,436 acres within the analysis area. Surface disturbance resulting from the implementation of the Proposed Action and Alternative A would remove an estimated additional 6,956 and 3,867 acres of yearlong sage grouse habitat, respectively. The removal of yearlong habitat under either alternative would displace some grouse into adjacent areas of similar habitat and would reduce the carrying capacity of the area to support grouse for the life of the project, or until reclamation efforts have replaced the sagebrush habitats that were removed during construction. The application of BLM seasonal occupancy restrictions would result in the avoidance of impacts to breeding and nesting activities and the implementation of a reclamation/habitat restoration plan would, over time, mitigate the long-term loss of sage grouse habitats.

4.9.6 Mitigation Summary

The mitigative measures presented in this section were developed in response to potential impacts on selected species identified in Section 4.9.3. Mitigation identified, although desirable on all lands, can only be required or enforced on BLM-administered lands. With the implementation of these measures, potentially adverse impacts to wildlife resources could either be directly avoided or reduced in severity. However, unless these prescribed avoidance and mitigation measures are applied to all lands within the affected analysis area, (fee and State lands as well as BLM lands) long-term significant impacts may occur.

4.9.6.1 General

To reduce incidents of illegal kill and harassment of wildlife, all project workers should be instructed on local wildlife regulations and State wildlife laws. Such regulations should be posted in conspicuous places at the job sites. Personnel should also be instructed about the nature of the wildlife species that occur on the work site, potential impacts to these species, and measures that could be taken to avoid or minimize impacts.

If production activity is found to adversely affect breeding or nesting sage grouse or raptors or big game winter use, the BLM, in consultation and cooperation with the Operator(s) and WGFD, could monitor operation and maintenance activity to identify reasonable opportunities for remediation.

4.9.6.2 Sage Grouse

In order to avoid the possibility of displacing sage grouse from nesting habitats, construction activities within a two-mile radius of active leks would be limited to the period extending from June 15 through March 1, or as designated by the BLM AO. Except for the variances provided for in the Kemmerer RMP, no activity would be allowed within 0.25-mile of an active sage grouse lek from March 15 through May 31. These variances provide that non- surface disturbing activities can occur near sage grouse leks from five hours after sunrise until two hours before sunset. One measure that can be taken to prevent the long-term loss of sage grouse nesting habitats is to avoid or reduce the placement of wells within areas of known activity. The Moxa Operators should, in coordination with the BLM and WGFD, develop a habitat enhancement plan that would mitigate the sage grouse nesting habitats that would be eliminated by construction and operation of production wells.

4.9.6.3 Raptors

In order to avoid the possibility of displacing raptors from active nest sites, construction activities within 0.25 to one mile (as designated by the AO) of known nest sites would be limited to the period extending from July 15 through February 1 (varies with species), or as designated by the BLM AO. The activity status of nests should be determined for nesting/breeding immediately prior to the commencement of construction activities.

4.9.6.4 Big Game

To the extent possible, construction and development activities within pronghorn crucial winter range should be minimized. In order to minimize the probability of displacing pronghorn from crucial winter habitats, construction operations within such ranges should be curtailed from November 15 through May 1, or as designated by the BLM AO.

The potential for vehicle/wildlife collisions could be reduced substantially by requiring all drivers to undergo a training session describing the type of wildlife in the area that are susceptible to vehicular collisions, the circumstances under which such collisions are likely to occur, and the measures that could be employed to minimize them. The probability of animal/vehicle collisions could be further reduced by imposing speed limits on roads which receive moderate use during daylight hours and less use during twilight periods and at night.

The total impact to antelope crucial winter range would be reduced over the long term by the reclamation of approximately 9.45 acres of habitat associated with each well with appropriate forb and shrub seed mixtures following the first fall when individual wells go on production. In order to mitigate the total amount of crucial winter pronghorn range that would be eliminated by construction and operation of the proposed wells within this habitat, Moxa Operators should participate in the Pronghorn and Livestock Mitigation Plan that is currently being developed to identify specific opportunities to reduce the impacts of oil and gas development on pronghorn and livestock.

If unsupervised rifle hunting within the well field needs to be prohibited (e.g., for safety reasons) and pronghorn densities reach levels that are higher than desired, special harvest measures should be applied to reduce numbers to desired levels. Such measures could include bow hunting, shot gun hunts with rifled slugs, and special rifle control hunts supervised by the WGFD and/or the Operators. The details for such special harvest measures must be coordinated with the WGFD and the BLM.

With the onset of a severe winter, development at the proposed level within elk severe winter relief habitat would likely create a significant adverse effect on the local elk population. Such impacts could be avoided or mitigated by curtailing activities on severe winter relief range during crucial winter periods and by strategic placement of wells in order to avoid these areas to the extent possible. Unless severe winters occur during the construction of wells, associated pipelines and roads, the project would not likely have any significant effect on elk populations. Due to the relative absence of elk from the analysis area, vehicle collision and poaching/harassment impacts to elk are expected to be minimal and insignificant as well.

4.9.6.5 Data Collection

Because sage grouse surveys were initiated too late in the season (early May) to adequately assess the status of most leks, additional aerial and ground surveys should be conducted prior to construction, during the peak of strutting and breeding activities (late March to early April), to provide an accurate determination of the number, location, and status of active leks within the analysis area. When active leks are located within 0.25 to one mile of proposed well placement and associated activities, specific mitigation actions should be formulated with the BLM, FWS, and the WGFD before construction activities occur.

Although the aerial survey of raptor nests was conducted at a reasonable time for locating nests, it was too early to determine the activity status of some species such as the Swainson's hawk. Ground checking of raptor nests was opportunistic and was associated with prairie dog colony mapping and was done too late in the season to adequately assess the activity and production status of most of the nests found. Additional aerial and ground surveys should be conducted prior to construction, during the peak of nesting activity (early June if only one survey is made), to provide an accurate determination of the number, location, and status of active raptor nests within the analysis area. When active nests are located within 0.25 to one mile of proposed well placement and associated activities, specific mitigation actions should be formulated with the BLM, FWS, and the WGFD before construction activities occur.

4.9.7 Residual Impacts

Although most of the potential impacts associated with the Proposed Action and Alternative A would not be significant, the effects of several impacts would persist until they were off-set over time. Such effects would include the long-term losses of crucial winter range for pronghorn, and nesting habitat for sage grouse. Unless prescribed avoidance and mitigation measures are applied to all lands (i.e., fee and State lands as well as BLM lands), long-term significant impacts may occur.

4.10 SPECIAL STATUS SPECIES

The material presented in this section and Section 3.10 are intended to satisfy the requirements for a biological assessment (BA) of potential impacts to species listed as threatened and endangered, and proposed species for listing. Although not required in a BA, impacts on other special status species including candidate species for listing and other rare species identified on the Wyoming Natural Diversity Database (WYNDD) or by the BLM are also included in this section.

4.10.1 Resource Management Objectives and Impact Significance Criteria

4.10.1.1 Resource Management Objectives

Special Status Plants

Management objectives emphasize the need to protect special status plant species. The Kemmerer RMP (USDI-BLM 1986) prescribes the following objectives and actions relative to special status plant species. Directions identified in the for riparian and wetland areas are also pertinent.

- No activities that would jeopardize the continued existence of threatened or endangered species will be allowed in habitat for those species.

- Appropriate measures to protect all threatened, endangered, and special status plant species will be applied to all actions and use authorizations. Measures could include avoidance, no surface occupancy, no surface disturbance, and seasonal restrictions.

Special Status Animals

- No activities that would jeopardize the continued existence of threatened and endangered species will be allowed in habitats for those species.

- Important wildlife habitat will be monitored to determine seasonal habitat use and to identify areas in need of habitat improvement. These areas include big game winter ranges, riparian areas, sage grouse strutting and nesting ares, wetlands, threatened and endangered species habitat, and non-game habitat.

Special Status Fish

Directions identified for special status animals also apply to special status fish.

4.10.1.2 Impact Significance Criteria

The following criteria were used to assess the significance of construction and operation of the proposed project on threatened, endangered, and other special status species. The latter includes species proposed for listing as threatened or endangered; federal candidate species; and species identified by a management agency (e.g., BLM, WGFD, Forest Service, etc.). These impact significance criteria were developed based on federal regulations, management directives, professional judgement, and involvement in other NEPA projects throughout the West.

Special Status Plants

Impacts to special status plants/habitat were considered significant if any of the following would occur:

- non-compliance with the Endangered Species Act (ESA);
- non-compliance with the management directives for the KRA; or
- removal or disturbance of special status plant species (or habitat judged important for survival) to the extent that such impact would threaten the viability of the local population and/or induce an upgrade in the federal, State, or resource area status.

Special Status Animals

Impacts to special status animals would be significant if any of the following were to occur:

- Non-compliance with existing BLM, FWS, or WGFD management objectives for wildlife, or non-compliance with BLM wildlife stipulations for surface occupancy criteria on oil and gas developments;
- The BA provided through this EIS, according to Section 7 of the ESA of 1973, concludes a "may affect" determination and would initiate formal consultation with FWS;
- The loss (death) of any individual from direct or indirect project-related causes including, but not limited to, recruitment rate reductions to viable populations; or
- Project-related impacts jeopardize or substantially decelerate the recovery program for any listed species.

Special Status Fish

In addition to the criteria presented in Section 4.7.2.2, the following criteria were used to determine the importance of impacts to special status fish species:

- Project-related impacts jeopardize or substantially decelerate the recovery program of any threatened, endangered, or candidate species.
- The loss or death of threatened, endangered, or candidate species from direct or indirect project-related causes.
- Average annual depletions of water from the Green River drainage in excess of 125 ac-ft would constitute a may affect determination.

4.10.2 Direct and Indirect Impacts

4.10.2.1 Proposed Action

Special Status Plants

Direct impacts to special status plants would include death or injury to individual plants and/or loss of habitat due to vegetative clearing and earth-moving activities such as would occur during well site construction, pipeline placement, or access road construction. Indirect impacts would include the short-term and long-term increased potential for weed invasion, establishment, and expansion; exposure of soils to accelerated erosion; shifts in species composition and/or changes in vegetative density; impacts of fugitive dust on photosynthetic capacity; stream dewatering; or changes in stream channel hydraulics as a result of road or pipeline placement. The latter two could affect Ute ladies'-tresses in particular.

Avoidance of all potential special status plant habitat areas would be difficult and/or infeasible because of the extensive occurrence of barren lands, vegetated sand dunes, cushion plant areas, semi-barren alkaline bottomlands, etc. Therefore, the potential for impacts to plant species with definite, likely, and probable habitat in the analysis area exists.

Given compliance with the RMP's 500-foot buffer zone from perennial streams, well site facilities would not impact Ute ladies'-tresses. Roads and pipeline R/W may need to cross perennial channels, however, and could affect areas of potential orchid habitat. The quality of potential orchid habitat is generally low due to salinity, lack of typical habitat elements, and overly active channel activity. There are, however, scattered areas of low to moderate potential habitat along the Hams Fork that could be adversely affected by channel crossings.

Water used for well construction would be obtained from State-approved locations on the Blacks Fork, Hams Fork, and Green River. Additional water would be obtained from water wells. Because orchid habitat often correlates with channels, modifications in streamflow beyond the existing condition could adversely affect potential habitat. Withdrawal of water from streams could potentially drop levels to the point where habitat and/or individuals of the orchid could reach a permanent wilting point before setting seed. Such an occurrence is unlikely, however, as water withdrawals would not all occur at the same time or to the extent that significant dewatering of perennial channels would occur.

The direct relationship between orchid occurrence and channel dynamics has not been established. With compliance to the RMP and with implementation of mitigation measures as directed in the Soil and Water Resources sections, no significant impacts to Ute ladies'-tresses orchid due to changes in channel hydraulics from pipeline and road construction are anticipated.

The extent of potential direct impacts to special status plant species cannot be determined at this point in the planning process as the magnitude is contingent on the site-specific location of proposed facilities and on the results of special status plant surveys. However, efforts to minimize disturbances in wetlands, barren lands, agricultural lands, and areas with steep slopes have been incorporated into Chapter 2. Such efforts would reduce the magnitude of impacts on many special status plant species (i.e., Opal phlox, Beaver Rim phlox, and Ute ladies'-tresses orchid) but could increase the effects on large-fruited bladderpod and contracted Indian ricegrass as project facilities are shifted to areas of alkali scrub and mixed desert shrub. Avoidance efforts would also reduce potential impacts to King's milkvetch, spinyleaf milkvetch, Eastwood plant, desert cryptantha, Swallen mountain ricegrass, Payson beardtongue, and dense twinpod but increase potential impacts on species that exploit sandy soils or vegetated sand dunes (i.e., spinyleaf milkvetch and desert cryptantha).

With compliance to the RMP and implementation of measures identified in Chapter 2, measures identified below in mitigation, and any additional measures identified by the BLM following surveys of facilities location sites, significant direct impacts to special status plant species are not anticipated. Implementation of mitigation measures to prevent/reduce fugitive dust and the potential for noxious or undesirable weed introduction and spread in areas of potential habitat would minimize the potential for negative indirect effects. Therefore, the proposed project is "not likely to adversely affect" Ute ladies'-tresses orchid and is "not likely to cause the listing" of candidate species.

Special Status Animals

Four species listed as endangered by the FWS under the ESA have the potential for occurrence on the project area. These include the black-footed ferret, bald eagle, whooping crane, and peregrine falcon. In addition, nine candidate species have the potential for occurrence on the project area: Preble's shrew, pygmy rabbit, white-faced ibis, ferruginous hawk, mountain plover, long-billed curlew, black tern, loggerhead shrike, and burrowing owl.

Black-Footed Ferret. An extensive amount of potential habitat for the black-footed ferret exists on the project area. If ferrets inhabit the area, the potential for the Proposed Action to significantly impact this species exists. As illustrated in Exhibits 3-14 and 3-15, a total of 161 white-tailed prairie dog colonies, collectively comprising an area of 47,664 acres, occur on the project area. Burrow density on approximately one percent of the project area equals or exceeds eight burrows per acre. The combined acreage of these areas (towns) is 3,982, which exceeds the 1,000-acre criteria established by the FWS for potential reintroduction sites. Because of the large numbers of prairie dogs found on the area (HWA 1994) and the relatively large number and consistent history of ferret sightings reported for this area (WGFD 1992b), the possibility of ferrets occurring here cannot be discounted. Although no recent evidence exists which indicates occupation of the analysis area by black-footed ferrets, numerous sightings of ferrets have been recorded within and proximal to the project area within the last decade (WGFD 1992b).

Potential impacts to this species that are associated with project activities include 1) direct loss of habitat, including prairie dog towns and burrows, resulting in a direct loss in prey base; 2) increased possibility for being struck by moving vehicles on existing and new roads; 3) increased possibility for being mistakenly shot as a prairie dog; and 4) possibility of being buried or otherwise injured if construction activities overlap active prairie dog burrows.

Assuming uniform distribution of proposed new wells over the project area, it is estimated that 1,949 acres of potential black-footed ferret habitat would be eliminated in the next ten-year planning period by the construction of wells and associated facilities. This constitutes approximately four percent of the potential ferret habitat within the analysis area. However, upon installation of the production facilities at each well, approximately 9.45 acres per well would be reclaimed. This would reduce the overall long-term surface disturbance from 1,949 acres to 744 acres. Following construction and subsequent reclamation of the pipeline, prairie dogs would be expected to re-colonize the pipeline corridor and establish burrows within the disturbed area. Burrow densities along the corridor could increase following pipeline construction since prairie dogs have an affinity for disturbed areas which provide a good burrowing medium and a ready supply of ground-level herbaceous forage.

In order to avoid impacting this species, consultation with the FWS to determine the necessity of conducting black-footed ferret searches prior to construction is recommended. The size, location, and burrow densities of prairie dog colonies in the analysis area have been described in detail in a Wildlife Technical Report (HWA 1994). If the Proposed Action is coordinated with the BLM and FWS, and the prescribed avoidance and mitigation measures listed in Section 2.2.4.2.9 are applied, impacts to this species are unlikely to occur.

Bald Eagle. Although bald eagles are common winter residents along the Green River from the Fontenelle Reservoir southeastward into the Seedskadee NWR, there have been no known sightings of roosting or nesting bald eagles within the project area. Consequently, the Proposed Action is not likely to adversely affect bald eagles.

Whooping Crane. Although 12 sightings of whooping cranes have been documented in areas proximal to the Moxa analysis area between 1981 and 1986, there have been no documented sightings on or near the project area since 1986 as documented in the WYNDD and WOS. As a result of limited wetland habitat availability in the project area and the termination of the cross-fostering program at Greys Lake NWR in Idaho, whooping crane use is highly unlikely. Therefore, the implementation of this alternative is not likely to adversely affect the species.

Peregrine Falcon. Despite the presence of suitable nesting habitat and an ample prey base within the project area, there were no peregrine falcons observed during surveys conducted in 1994 (HWA 1994), and only two sightings of peregrine falcons have been documented in the WOS for the entire region surrounding the analysis area. There is no evidence that indicates that the analysis area is used by the peregrine falcon, except on an occasional migratory basis; therefore, implementation of this alternative is not likely to adversely affect the species.

Preble's Shrew. Although there is a potential for Preble's shrew in the area, no observations of Preble's shrew were made in the analysis area during field surveys (HWA 1994) nor are there any documented occurrences of Preble's shrew within or proximal to the project area in the WOS or the WYNDD, Based on the lack of documented evidence, the reported distribution of the species, and habitats present on the area, the Preble's shrew is unlikely to be present; therefore, this alternative is not likely to cause the listing of this species.

Pygmy Rabbit. Assuming uniform distribution of proposed new wells over the analysis area, a minimum of 354 acres of pygmy rabbit habitat would be eliminated by surface disturbance and other activities related to gas well installation and production (Exhibit 4-6). The loss of pygmy rabbit habitat could result in the direct mortality of some individuals and displacement of others into surrounding areas of lesser quality habitat. Therefore, in the absence of appropriate avoidance and mitigation measures, the Proposed Action may adversely affect pygmy rabbit populations in this area. This impact could be prevented by avoiding well

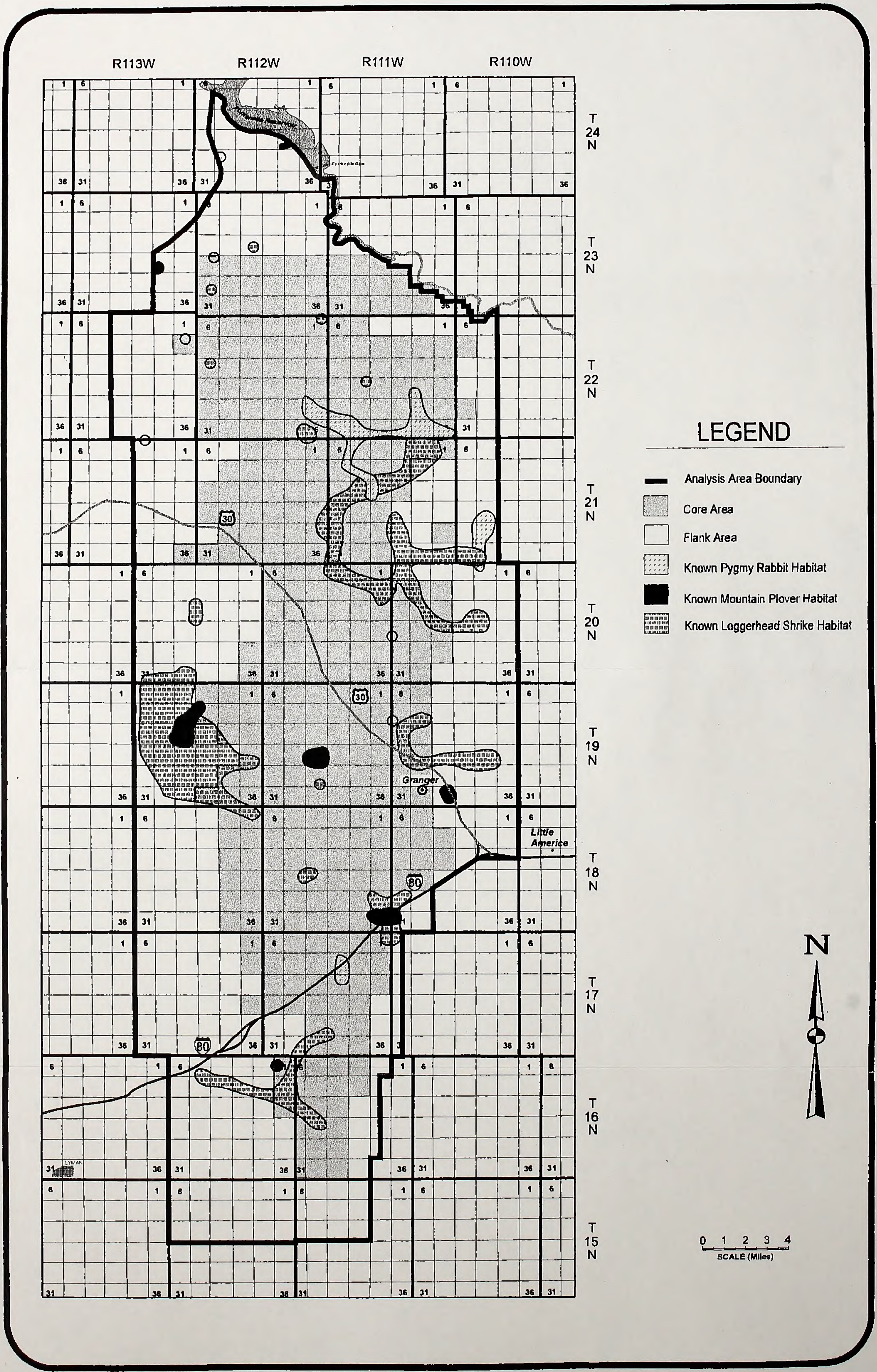

Exhibit 4-6. Habitat for Various Candidate Species Shown in Relation to the Current Production Area and Flank Area.

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placement within areas of known pygmy rabbit habitat, the most significant of which lies within R110-111W, T21-22N (Exhibit 4-6).

White-Faced Ibis. No white-faced ibises were seen in the study area during field surveys conducted in 1994 (HWA 1994); however, the WOS does contain documentation of five occurrences within the analysis area. Because these sightings are from areas removed from adjacent sources of permanent water, their presence in the area was likely transitory. Extensive water and emergent vegetation are rare within the analysis area, and ibis use, beyond casual migratory transition, is highly unlikely. Therefore, the implementation of this alternative is not expected to adversely affect the white-faced ibis.

Ferruginous Hawk. An aerial inventory completed in 1994 (HWA 1994) revealed at least 14 ferruginous hawk nests within the project area. Of these, only four were active and the status of the remainder was unknown. The primary possible impact to ferruginous hawks from project activities is disturbance during nesting that may result in reproductive failure. This would be mitigated by prohibiting project activities within a 0.25- to 0.5-mile radius of active ferruginous hawk nest sites from March 1 through July 31. On the basis of current use, natural topographic barriers, and the judgement of the BLM AO, the size of the buffer zone may vary. From 126 to 503 acres per occupied nest could be subject to seasonal restrictions with total acreage varying with the number of active nests. For this reason, an activity status survey of raptor nests should be conducted immediately prior to construction to allow for well placement planning and the avoidance of impacts to actively nesting birds. With the implementation of seasonal restrictions, there would be no adverse impacts to ferruginous hawks under this alternative.

Mountain Plover. Assuming uniform distribution of proposed new wells over the project area, a minimum of 153 acres of known mountain plover habitat would be eliminated by the development of approximately ten wells and associated facilities within the project area (Exhibit 4-6). Fifteen individual sightings of mountain plover were made within the study area during surveys conducted in 1994 (HWA 1994), and many of these were juvenile birds. Therefore, this species is believed to actively nest within portions of the Moxa analysis area.

A significant impact to mountain plover would occur if either a moderate portion of their nesting habitat were removed or if an active nest were disturbed during the incubation period or before the young have become fully mobile. This impact would be prevented by avoiding construction in known plover habitats during the nesting period from late April through mid-June, and/or avoiding well placement within areas of known mountain plover habitat. Because the status of nests may change from year to year, activity status and location must be current to allow for the planning of impact avoidance. For this reason, a search of suitable habitat in the vicinity of areas where disturbance is scheduled is recommended prior to construction.

Long-Billed Curlew. No long-billed curlews were observed in the Moxa analysis area during surveys conducted in 1994 (HWA 1994), and sightings as documented in the WOS have been few within the region. Although marginal habitat for curlew nesting and migration is available within the analysis area, preferred habitat (proximity to open lakes and sloughs) is nearly non-existent. Therefore, the implementation of this alternative is not expected to adversely affect this species.

Black Tern. No black terns were seen within the analysis area during surveys conducted in 1994 (HWA 1994) nor are there any recorded sightings within the project area as reported in either the WOS or WYNDD. Although the WOS contains sightings of black terns along the Green River directly adjacent to the northeast corner of the project area, the most recent of these is from 1982. Also, suitable habitat for the black tern (i.e., marshes) does not occur within the analysis area per se. There have been no documented sightings since 1982 and their continued presence within the immediate area seems unlikely. Thus no adverse impacts to this species are expected as a result of the implementation of this alternative.

Loggerhead Shrike. Assuming uniform distribution of proposed new wells over the project area, an estimated 115 of the 1,325 wells (nine percent) would be drilled within known loggerhead shrike habitat (Exhibit 4-6). The development of these wells and associated facilities would remove a minimum of 1,763 acres of loggerhead shrike habitat. This represents over four percent of the total known habitat available to loggerhead shrikes within the analysis area.

Although loggerhead shrikes are largely unaffected by human disturbance, they can be susceptible to disturbance during the nest building and incubation period. Bent (1950) reported that loggerhead shrikes in California will cease nest construction if approached within 150 feet. Impacts to loggerhead shrikes may occur through direct removal of nesting and feeding habitat or through human disturbance during nesting as a result of project activities. These impacts would be prevented by avoiding construction during the nesting period from early April through mid-July and/or avoiding well placement within areas of known loggerhead shrike habitat. Thus, no adverse affects to this species are expected with implementation of this alternative.

Burrowing Owl. Assuming uniform distribution of proposed new wells over the project area, an estimated 127 of the proposed 1,325 wells (ten percent) would be drilled within burrowing owl habitat. The development of these wells along with associated roads and pipelines would remove approximately 1,949 acres of potential burrowing owl nesting habitat (i.e., prairie dog colonies). This amounts to approximately four percent of the total habitat available to burrowing owls within the project area. The removal of this habitat could displace some burrowing owls into surrounding areas. Because these areas contain thousands of acres of prairie dog colonies which constitute prime nesting habitat of this species, such displacements are not expected to produce adverse or irretrievable impacts. Given the application of avoidance and mitigation measures described in Section 2.2.4.2.10 and further presented in this section, including seasonal restrictions applicable to raptor nests, adverse impacts to burrowing owls are not expected.

Special Status Fish

The principal fisheries impacts likely to be associated with the Proposed Action and alternatives include 1) increased stream sedimentation; 2) downstream water pollution from accidental discharge of toxic substances; and 3) water flow depletions from the Hams Fork, Blacks Fork, or Green River. Although the intermittent tributary drainages within the Moxa analysis area do not support fish populations, construction and operation activities have the potential to deposit sediments and toxic substances into these stream courses during high water runoff that could affect downstream fish populations in the Hams Fork, Blacks Fork, and Green River.

As described in Section 3.10, four species of fish classified as endangered and three species classified as Candidate 2 occur downstream from the Moxa analysis area. Endangered species include the Colorado squawfish, humpback chub, bonytail chub, and razorback sucker, and the Candidate 2 species include the leatherside chub, flannelmouth sucker, and roundtail chub. Although these species occur many miles downstream of the Moxa analysis area, flow depletions in upstream drainages could potentially affect survival and recovery of these species when the cumulative impacts of such depletions are assessed.

Under this alternative, water needed for drilling and testing operations would be obtained from local water source wells and streams. At a minimum, an estimated 2,195 ac-ft would be withdrawn from the Hams Fork, Blacks Fork, and Green rivers over the ten-year period, or an average of 220 ac-ft per year. This could impart a low level, short-term impact to area fisheries due to changes in water level, increased erosion and sedimentation, and increase in turbidity levels. Many of these impacts could be avoided or lessened in severity by the implementation of mitigative measures described in Chapter 2.

Although the Endangered fish species of the Colorado River System currently exist only downstream from this project area, water from the Upper Green River basin affects the downstream habitat for these fish. Under the Recovery and Implementation Program for Endangered Fish Species in the Upper Colorado River Basin (RIP), any water depletions from tributary waters within the Colorado River drainage are considered to be jeopardizing the continued existence of these fish. Tributary water is defined as water that contributes to instream flow habitat. Depletion is defined as water which would contribute to the river flow if not intercepted and removed from the system.

The average annual depletion of water would be greater than 125 ac-ft. Although potential indirect effects that might be created by water depletion impacts would be reduced to non-significant levels through implementation of the "Windy Gap Process", the action alternatives are not likely to affect listed fish species because of the relatively small amount of water that might be withdrawn would have little affect the operation of the

Flaming Gorge Dam and the instream flows through the critical habitat areas downstream from the dam.

4.10.2.2 Alternative A

Special Status Plants

Given the lesser area of land that would be affected, impacts to special status plant species and/or habitat would be lower under Alternative A than under the Proposed Action. Project implementation would primarily affect special status species that occur in areas of the mixed desert shrub cover type. However, stipulations prescribed in the RMP (USDI-BLM 1986) and measures committed to by the Moxa Operators (Chapter 2) would preclude significant impacts. Implementation of this alternative is "not likely to adversely affect" *Spiranthes diluvialis* and is "not likely to cause the listing" of this candidate species.

Special Status Animals

Alternative A encompasses the same area as the Proposed Action, so the same endangered and candidate species discussed under the optimum development alternative will be addressed with this alternative.

Black-Footed Ferret. Although the amount of potential black-footed ferret habitat eliminated under Alternative A (1,353 acres) is less than for the Proposed Action (1,949 acres) and the potential for impacts to ferrets is somewhat lower, the analysis for Alternative A is identical to that previously described under the Proposed Action.

Bald Eagle. The analysis for Alternative A is identical to that previously described under the Proposed Action.

Peregrine Falcon. The analysis for Alternative A is identical to that previously described under the Proposed Action.

Preble's Shrew. The analysis for Alternative A is identical to that previously described under the Proposed Action.

Pygmy Rabbit. Assuming uniform distribution of proposed new wells over the project area, a minimum of 153 acres of pygmy rabbit habitat would be eliminated by the development of approximately ten wells and associated facilities within the project area (Exhibit 4-6). The impacts and mitigation opportunities would be the same as described under the Proposed Action.

White-Faced Ibis. The analysis for Alternative A is identical to that previously described under the Proposed Action.

Ferruginous Hawk. The analysis for Alternative A is identical to that previously described under the Proposed Action.

Mountain Plover. Although the amount of plover habitat eliminated under Alternative A (92 acres) is less than for the Proposed Action (153 acres) and the potential for impacts is proportionately lower, the analysis for Alternative A is identical to that previously described under the Proposed Action.

Long-Billed Curlew. The analysis for Alternative A is identical to that previously described under the Proposed Action.

Black Tern. The analysis for Alternative A is identical to that previously described under the Proposed Action.

Loggerhead Shrike. Under this alternative, an estimated 65 of the proposed 795 wells (eight percent) would be drilled within known loggerhead shrike habitat (Exhibit 4-6). The development of these wells and associated facilities would remove a minimum of 995 acres of loggerhead shrike habitat. This represents approximately two percent of the total known habitat available to loggerhead shrikes within the analysis area and constitutes a two percent reduction in habitat as compared with the Proposed Action. The impacts and mitigation opportunities would be the same as described under the Proposed Action.

Burrowing Owl. Assuming uniform distribution of proposed new wells over the analysis area, an estimated 89 of the proposed 795 wells (11 percent) would be drilled within potential burrowing owl habitat. Total well and associated road and pipeline construction would physically remove approximately 1,363 acres of potential burrowing owl nesting habitat (i.e., prairie dog colonies). This amounts to approximately 2.7 percent of the total habitat available to burrowing owls within the analysis area. The removal of this habitat could displace some burrowing owls into surrounding areas. Because these areas contain thousands of acres of prairie dog colonies, which constitute prime nesting habitat of this species, such displacements are not expected to produce adverse or irretrievable impacts. Given the application of avoidance and mitigation measures described in Section 2.2.4.2.10 and further presented in this section, including seasonal restrictions applicable to raptor nests, significant impacts to burrowing owls are not expected.

Special Status Fish

Under this alterative, a minimum of approximately 1,317 ac-ft would be withdrawn from the Hams Fork, Blacks Fork, and Green River as needed for drilling and testing operations over the ten-year period or 132 ac-feet annually. This represents a 40 percent reduction in the amount of water withdrawn over the Proposed Action.

The nature of low-level impacts to fisheries from Alternative A would be the same as those under the Proposed Action except that the magnitude of impacts would be marginally lower under this alternative. As with the Proposed Action, the "Windy Gap Process" would be applied as a mitigative measure under this alternative.

4.10.2.3 Alternative B - No Action

Special Status Plants

Under the No Action alternative, the loss of upland cover types providing habitat for special status plants likely would be proportional to their abundance in the analysis area. Impacts to special status plants/habitat would continue to be addressed on a case-by-case basis by the BLM based on rare plant surveys performed prior to earth-surface disturbance activities. The BLM would continue to identify appropriate mitigation to prevent significant impacts on a facility-specific basis. Implementation of this alternative is "not likely to adversely affect" Ute ladies'-tresses orchid and is "not likely to cause the listing" of candidate species if recommended mitigation measures are consistently applied on all lands.

Special Status Animals

Under the No Action alternative, the proposed project would not be constructed. Adoption of this alternative would, however, still allow for build-out of previously authorized activities as well as construction of wells under APDs approved by the WOGCC for State and private lands on a case-by-case basis. Nevertheless, implementation of this alternative would eliminate some of the short- and long-term impacts associated with the implementation of the Proposed Action and Alternative A. As a result, impacts related to wildlife resources within the analysis area and adjacent lands would consist mainly of hunters who travel existing roads, current oil and gas production, and livestock grazing.

Special Status Fish

Under the No Action alternative, the proposed project would not be constructed but there would be continued build-out of previously authorized activities as well as approval of APDs for State and private land as granted by the WOGCC on a case-by-case basis. Adoption of this alternative would result in fewer short- and long-term impacts associated with the implementation of either the Proposed Action or Alternative A.

4.10.3 Impacts Summary

Special Status Plants

All project alternatives have the potential to affect special status plants/habitat. Direct impacts could occur from injury of individuals or loss of habitat. Indirect impacts could occur from increased competition with weeds or increased fugitive dust. The magnitude of such impacts cannot be defined without site-specific information on the location of proposed facilities or site-specific surveys for special status plants/habitats.

Avoidance of wetlands, barren lands, agricultural lands, and areas with steep slopes would reduce the potential for impacts to Opal phlox, Beaver Rim phlox, and Ute ladies'-tresses orchid, King's milkvetch, spinyleaf milkvetch, Eastwood plant, desert cryptantha, Swallen mountain ricegrass, Payson beardtongue, and dense twinpod. Such efforts at avoidance, however, could potentially increase the impacts to special status plant species found in non-sensitive soils within the mixed desert shrub cover type (i.e., contracted Indian ricegrass) and areas of alkali scrub (i.e., large-fruited bladderpod) as well as species such as spinyleaf milkvetch and desert cryptantha that are found on sandy soils.

Given compliance with the ESA and the RMP, implementation of measures identified in Chapter 2, and implementation of appropriate mitigation measures identified below and by the BLM (as necessary), no significant impacts are anticipated to any special status plant species/habitat. All of the alternatives are "not likely to adversely affect" *Spiranthes diluvialis* and are "not likely to cause the listing" of candidate species.

Special Status Animals

With the implementation of either the Proposed Action or Alternative A, direct loss of habitat would result from surface disturbance associated with the construction of well sites and related access roads and pipelines. In addition, some wildlife species would be indirectly impacted by displacement from habitats in the vicinity to the project area due to the presence of human activities associated with the construction and operation of wells. The potential for collisions between wildlife and motor vehicles would also increase due to the construction of new roads and increased traffic levels on existing roads. The severity of these impacts would be expected to decrease with the completion of the construction phase and with the onset of reclamation efforts on many of the disturbed areas.

The nature of impacts to wildlife is identical between the Proposed Action and Alternative A. The magnitude of potential impacts would be greater under the Proposed Action, however, because of the greater number of well sites and miles of associated access roads. Table 4-11 summarizes the amount of loss in wildlife habitat in a comparative format for the two alternatives considered. As seen on Table 4-11, the total disturbance associated with the core area is the same for both alternatives. The reduction in the total amount of habitat removed with Alternative A is attributed to the lower number of wells proposed for the flank area under this alternative. With the implementation of Alternative A, from 31 to 72 percent less wildlife habitat would be affected than with the Proposed Action.

Special Status Fish

Potential impacts to fisheries resources include the degradation of surface water quality, an increase in stream flow from surface runoff, and a decrease in stream flow from the consumption of groundwater. However, given the avoidance and mitigation measures described in Chapter 2 and in Section 4.10.5), no significant impacts are expected.

Because the endangered and candidate species are so far removed from the Moxa analysis area, no direct effects to them are anticipated. Any potential indirect effects that might be created by water depletion impacts would be reduced and mitigated through implementation of the "Windy Gap Process"--which requires proponents to pay into a conservation fund for the recovery program of the fish.

4.10.4 Cumulative Impacts

Special Status Plants

As indicated previously, the Moxa analysis area is not pristine. All of the project alternatives would increase existing impacts to vegetation cover types with potential to support individuals/habitat of special status plants. Measures in Chapter 2 and Chapter 4 Soils would effectively shift some of the impacts from barren lands, agricultural lands, wetlands, and steep slope areas to non-sensitive areas of the mixed desert shrub cover type as well as areas of vegetated sand dunes and alkali scrub. Impacts to vegetation cover types would be reduced upon reclamation during the production phase (see Section 4.5); however, the ability to reclaim habitat for special status plant species is uncertain at best.

Based on field observations for this project and on qualitative observations (ECOTONE 1994, 1995b; Fertig 1994), limited habitat disturbance may be beneficial--or at least neutral-- for some special status plant species (e.g., such as spinyleaf milkvetch, Ute ladies'-tresses, and contracted Indian ricegrass). For other species, the effects of disturbance are negative. As such, the potential for cumulative impacts to special status plant species and/or habitats with the action alternatives could be considerable given the propensity of the analysis area to contain special status plants and the lack of comprehensive surveys to identify species and habitat. With avoidance and implementation of proposed and recommended mitigation measures, cumulative impacts to special status plant species/habitats are not projected to be significant. Cumulative impacts of the alternatives are "not likely to adversely affect" Ute ladies'-tresses orchid and are "not likely to contribute to the need to list" candidate species.

Special Status Animals

The analysis of cumulative impacts from the development of gas wells and associated facilities assumes a uniform distribution of well sites over the entire project area, based on existing WOGCC-approved spacing within individual fields. Table 4-12 summarizes the amount of potential disturbance associated with the two alternatives in relation to existing levels of disturbance.

Black-footed Ferret. Existing disturbance to prairie dog colonies within the analysis area has reduced the acreage of this habitat by approximately 623 acres. This represents 1.3 percent of the total potential habitat available to black-footed ferrets (if present) and to burrowing owls. Under the Proposed Action, an estimated 1,949 additional acres of prairie dog colonies would be removed over the short term, resulting in the reduction of approximately four percent of the total available habitat associated with prairie dog colonies in the project area. As a result, the cumulative total area disturbed within prairie dog colonies would increase to 5.3 percent.

Surface disturbance resulting from the actions of Alternative A would initially remove an estimated 1,353 acres of potential black-footed ferret and burrowing owl habitat within prairie dog colonies. This represents approximately three percent of the total acreage of prairie dog colonies within the project area and brings the cumulative total disturbance to 4.3 percent.

Pygmy Rabbit. Existing disturbance within known pygmy rabbit habitat has only reduced the amount of habitat available to this species by 0.4 percent. A minimum of 354 and 155 acres of known pygmy rabbit habitat would be eliminated within the project area under the Proposed Action and Alternative A, respectively. This would result in an additional reduction in approximately 4.0 and 1.7 percent of known pygmy rabbit habitat under the respective alternatives and bring the cumulative total disturbance to 4.4 and 2.2 percent, respectively. Pygmy rabbit populations could be adversely affected under either alternative, however, these impacts would be offset by avoiding well placement within areas of known pygmy rabbit habitat.

Preble's Shrew. Although there is a potential for Preble's shrew in the area, no observations of Preble's shrew were made in the project area during field surveys (HWA 1994) nor are there any documented occurrences of Preble's shrew within or proximal to the analysis area in the WOS or the WYNDD. Based on the lack of documented evidence, the reported distribution of the species, and habitats present on the area, the shrew is unlikely to be present and there should be no adverse impacts as a result of this alternative.

Mountain Plover. The extent of existing disturbance within known mountain plover habitat has reduced the total acreage of this habitat by approximately 2.5 percent. Assuming uniform distribution of proposed new wells over the project area, a minimum of 158 and 92 acres of known mountain plover habitat would be eliminated within the analysis area under the Proposed Action and Alternative A, respectively. This represent a 4.2 and 2.5 percent reduction in the total available known habitat for mountain plovers in the project area, and together with existing disturbance, raises the cumulative total to 6.7 and five percent respectively under the Proposed Action and Alternative A.

Quantification of known plover habitat was based on a totalling of the acreage upon which plover were observed during the July and August 1994 prairie dog mapping work (HWA 1994). Because survey efforts were limited to just prairie dog colonies and the survey dates extended well into August, it is likely that some mountain plover habitat went undiscovered. Nevertheless, at least 92 to 158 acres of mountain plover habitat would be lost and constitutes a significant impact. Impacts could be prevented or greatly reduced by avoiding well placement, or greatly reducing the density of wells placed, within areas of known mountain plover habitat, and by avoiding construction during the nesting period from late April through mid-June and within areas of known mountain plover habitat.

Loggerhead Shrike. The degree of existing disturbance within known loggerhead shrike habitat has reduced the amount of habitat available to this species by 402 acres or one percent. A minimum of 1,763 and 993 acres of known loggerhead shrike habitat would be eliminated within the project area by the implementation of the Proposed Action and Alternative A, respectively. This represents an additional reduction in approximately 4.2 and 2.4 percent of known loggerhead shrike habitat under the respective alternatives and brings the cumulative total disturbance to 5.2 and 3.4 percent, respectively. Consequently, loggerhead shrike populations could be adversely affected under either alternative; however, these impacts would be prevented by avoiding construction during the nesting period from early April through mid-July and reducing or avoiding well placement within areas of known loggerhead shrike habitat. The addition of suitable native shrub species to the reclamation mix would also accelerate the re-establishment of shrike nesting habitat.

Burrowing Owls. Black-footed ferrets (if present) would likely be affected by the proposed level of development under either alternative, but burrowing owls would not. As previously mentioned, numerous sightings of ferrets have been recorded within and in proximity to the project area within the last decade (WGFD 1992b); consequently, their local presence cannot be ruled out. For this reason, surface disturbance would not be permitted until after the completion of ferret surveys. The FWS would be consulted for their recommendations on ferret surveys and the status of the project area as a potential reintroduction site for black-footed ferrets.

Special Status Fish

The magnitude and extent of present sources of water depletion along the Green River and its tributaries is currently undetermined. Therefore, the cumulative effect of the estimated 2,195 and 1,317 ac-ft that would be withdrawn from local sources of water over the ten-year period under the respective alternatives of the Proposed Action and Alternative A is unknown.

Although none of the endangered or candidate species of fish are likely to occur above the Flaming Gorge Dam, the potential exists to affect these species downstream as a result of project generated flow depletion in the Green River and its tributaries. Such a depletion, when considered cumulatively along with other undetermined sources of depletion in the project area could result in low-level impacts to these species.

According to the "Windy Gap Decision" of the FWS (as amended 5 July 1994), any average annual water depletion that exceeds 125 ac-ft has been identified by the FWS to have an adverse effect on the survival and recovery of endangered fish species in the Colorado River System. Although the flows of many tributaries in the upper basin have been modified, flow in the mainstem Green River is controlled by Flaming Gorge Dam, and the resultant impacts on fish habitat are difficult to assess. Therefore, the "Windy Gap Process" was developed to facilitate the calculation of flow depletions on a cumulative basis and the assessment of user fees to promote recovery of these species through monitoring research, habitat manipulation, and fish culture.

The "Windy Gap Process" would be applied as a mitigative measure for potential surface water impacts to endangered and threatened fish of the Colorado River System.

4.10.5 Mitigation Summary

Mitigation measures would be applied consistently for special status wildlife and fish species on State and private lands but may not be applied consistently for special status plant species.

Special Status Plants

Mitigation measures committed to by the Moxa Operators (Chapter 2) include site-specific recommendations being developed by an IDT for staked facilities; minimization of impacts due to clearing and soil handling; noxious weed monitoring and control; compliance with Section 404(b)(1) guidelines of the federal CWA; and clearance surveys for special status plant species.

By way of clarification, on-the-ground clearance surveys would be performed for special status plant species identified by the WYNDD, FWS, and BLM. Such species include those listed as threatened or endangered, species proposed for listing, and species that are candidate Category 1 and 2 for federal listing. As species may be added or deleted to the list identified in this EIS, these organizations should be contacted for the most current list of species prior to performing site-specific surveys. Surveys should be performed during optimal season(s) for the plant identification as recommended by the BLM, WYNDD, or FWS. For some species (e.g., large-fruited bladderpod), this may require visits during both the flowering and fruiting periods. If impacts to special status plants/habitat are identified during site-specific surveys, the BLM will determine specific measures necessary to prevent significant impacts.

Surveys for the federally listed (threatened) Ute ladies'-tresses orchid should follow the "Colorado protocol" (USDI-FWS 1992). If the orchid is found during clearance surveys, formal consultation with the FWS will be required.

In addition to mitigation measures committed to by the Operators and those recommended in the Soils and Water Resources sections of this chapter, the following measures could further reduce impact to special status plants and/or habitat. Measures could include altering the well pad configuration, shifting the location of a facility (well site, pipeline, access road, etc.), using a narrower ROW width, or seasonal restrictions on water withdrawals during the summer. Implementation of such measures would depend on the results of site-specific surveys.

Special Status Animals

The mitigative measures, presented within the discussions for each alternative, were developed in response to potential impacts on the species identified. With the implementation of these measures, potentially adverse impacts to wildlife species of concern could either be directly avoided or reduced in severity.

Special Status Fish

For water depletions in the Hams Fork, Blacks Fork, or the Green River, Moxa Operators would be required to support the "Windy Gap Process" conservation measure to offset possible impacts and avoid jeopardy to the endangered and candidate fish species of the mainstem Green River and upper Colorado River Basin. Contribution of funds to the FWS should be based on average annual depletion of surface water flow that might result if water that might otherwise contribute to this flow is used for construction and drilling operations. No additional measures beyond those already presented in this section and in Chapter 2 of this analysis would be required.

4.10.6 Residual Impacts

Special Status Plants

Loss of special status plants and/or habitat would represent an irreversible and irretrievable commitment of resources. The magnitude of such loss is not known but would be determined upon site-specific surveys for each proposed facility. Nevertheless, mitigation measures would ensure that such loss is avoided or minimized per the BLM's recommendations. All of the alternatives are "not likely to adversely affect" *Spiranthes diluvialis* and are "not likely to cause the listing" of candidate species. If mitigation measures are not consistently implemented on State and private lands, the resultant impacts to special status plants could be of greater magnitude than identified.

Special Status Animals

Although most of the potential impacts associated with the Proposed Action and Alternative A would be non-significant, the effects of several would persist until they were off-set over time. Such effects would include the long-term losses of existing habitat for pygmy rabbit, mountain plover, and loggerhead shrike. Temporary losses of habitat for the black-footed ferret (if present) and burrowing owl would be apparent by the reduction of total prairie dog town acreage.

Special Status Fish

With full implementation of the mitigation measures contained in this section and in Chapter 2, no adverse residual impacts to special status fish species are expected.

4.11 VISUAL RESOURCES

4.11.1 Introduction

Both short-term and long-term impacts to the visual resource could be possible where patterns of area, line, form, color, and texture in the characteristic landscape would be contrasted by drilling equipment, production facilities, and/or construction related damage to vegetation, topography or other visible features. The severity of impact depends upon the scenic quality, sensitivity level, and distance zone of the affected environment; the reclamation potential of the landscape disturbed; and the level of disturbance to the visual resource created by the Proposed Action. In general, impacts would be most severe on sites where mitigation would be difficult and where visual contrasts would be highly visible to potentially large numbers of viewers.

4.11.2 Resource Management Objectives and Impact Significance Criteria

4.11.2.1 Resource Management Objectives

The Kemmerer RMP (USDI-BLM 1986) indicates the following objectives for visual resources:

- Visual resources will continue to be evaluated as part of activity and project planning. Visual resource management (VRM) classes will be updated as situations change so that appropriate baseline information is included in the project planning level. Such evaluations will consider the need for the proposed project and the visual sensitivity (e.g., VRM classification) of the area. Stipulations will be attached to ensure compatibility of projects with management objectives for visual resources.

- Generally, activities within VRM classes of I through IV will be allowed only when the activity complies with the constraints identified for each VRM class. However, the incompatibility of a specific action with an area's VRM classification would not, in and of itself, constitute non-conformance with the RMP because the management objectives for other resources will also be taken into account.
- Large, long-term facilities will be required to be colored to blend with the natural environment when this is not in conflict with safety or with the purpose for which the facility has been designed.

Further, standard stipulations for oil and gas leases indicate that surface disturbance would be prohibited 1) within important scenic areas (Class I and II VRM areas) and 2) within a quarter mile or visual horizon [whichever is closer] from a historic trail.

BOR standards for the foreground of views from rivers or reservoirs state that drilling can occur as a short-term impact. However, once drilling has been completed, no permanent fixed facilities can be visible.

4.1.2.2 Impact Significance Criteria

A visual impact would be considered significant if the level of contrast produced by the Proposed Action would:

- exceed the level of contrast permitted in a VRM Class and could not be returned to an acceptable level;
- not comply with the RMP;
- create changes in overall character from Common Natural to Common Natural/Human Influenced and from Common Natural/Human Influenced to Human Dominated Combined (in conjunction with other present actions, proposed future actions, and potential actions permitted under management direction).

4.11.3 Direct and Indirect Impacts

4.11.3.1 Proposed Action

As mentioned in the Affected Environment section there is considerable evidence of previous disturbance in the Moxa analysis area. Rural communities, ranches, and agricultural areas are highly visible. Many off-road vehicle tracks have been created by past livestock management practices, recreationists, and mineral search and development activities. An estimated 126 existing oil and gas facilities are visible from major highways in the region. Numerous access roads and pipeline corridors are also visible.

Under the Proposed Action, short-term impacts to the visual resource would include contrasts in line, form, color, and texture associated with drilling rigs, construction equipment, service trailers and the general industrial character of drilling operations. The Proposed Action, 1,325 new well sites (most on individual pads) would add an estimated 9,265 acres (3.4 acres per site) to the existing level of well field related disturbance. In addition, 795 miles of new road and 1,457 miles of new pipeline would disturb an additional 13,648 acres of the existing landscape. This would add an estimated 2,750 miles of strongly contrasting line.

This estimated increase in disturbed area assumes some use of existing roads. Drilling site locations that would be visible from I-80, Wyoming Highways 30 and 189, and the railroad (potentially as many as 700 existing and proposed sites) in the Class II and III zone would affect the greatest number of viewers. These short-term impacts would exceed the level of contrast permitted in Classes II, III, and IV. However, because these impacts would be short-term, and only a few drilling rigs would be operating at any one time in the most visible areas, they would not be considered significant.

Long-term adverse impacts associated with fixed structures (e.g., access roads, pipelines, well heads, and production facilities) would remain once drilling activities were completed. Fugitive dust would also continue. Roads and fixed facilities associated with potentially as many as 994 new production sites could remain visible from I-80, U.S. 30, U.S. 189, and the railroad. Of the 556 square miles of potentially visible area, 115 square miles would be in the foreground of these viewsheds. Well sites constructed in visible areas would add to the impact of the estimated 126 visible existing oil and gas facilities. The severity of impact of the Proposed Action would increase in direct proportion to the number of production facilities, roads and pipelines located in the I-80, railroad, U.S. 30, and U.S. 189 viewsheds; particularly well sites in the foreground of the viewshed.

Successful implementation of recommended mitigation measures outlined in Chapter 2 would reduce contrasts to levels permitted in the Class IV zone. Impacts would not be considered significant. These contrasts would, however, detract from the experience of motorists, particularly tourists, Amtrack passengers, and backcountry recreationists. If all 700 estimated potential existing and proposed locations in Class II and III zones in the viewshed described above were developed, the impact would be significant. Site-specific location decisions that take advantage of topographic screening should minimize visual impacts in some locations. However, successful implementation of recommended mitigation measures as detailed in Chapter 2, would reduce contrasts but not to levels that would "not be evident in the characteristic landscape," (Class II) or would "be subordinate to the existing landscape" (Class III). If implemented, mitigation measures as outlined in the Mitigation Summary would bring the levels of contrast into compliance with BLM VRM criteria for Class II and III zones. It should be noted that existing development on private property in Viewshed 5 (U.S. 30) may already exceed Class III level of contrast criteria.

4.11.3.2 Alternative A

The impacts associated with Alternative A would be similar to those described for the Proposed Action. However, the 40 percent reduction in the number of well sites in this alternative could reduce the overall impact substantially. The reduction in impact would be most pronounced if the highest percentage of this 40 percent reduction were to occur in Class II and III VRM zones; reductions to levels of acceptable impact are recommended in the Visual Resource Mitigation Section. Compliance with these mitigation standards would result in no significant impact. The greater the increase in well density in VRM Class II and III zones, the greater the probability of significant impacts.

4.11.3.3 Alternative B - No Action

There would continue to be changes to the visual resource under the No Action alternative. Additional APD and ROW Actions could be granted by the BLM and/or the WOGCC on a site-by-site basis. Depending on site-specific conditions, adverse long-term impacts could remain. The density of wells under the No Action alternative would likely be lower than the Proposed Action. Impacts would not be significant in Class IV zones. If the density of site development remains low (two drill sites or less per square mile) in Class III zones, the impacts would not be considered significant. However, as well site density approaches those specified in the Proposed Action (four well sites per square miles), impacts would be significant in Class III zones. Impacts of additional wells located in Class II zones beyond those already existing, would be considered significant. Overall, the impacts to the visual resource associated with the No Action alternative would be lower than those associated with the Proposed Action.

4.11.4 Impact Summary

Adverse impacts from well construction would occur within the short term due to contrast in line, form, color and textures associated with equipment, surface disturbance, and fugitive dust juxtaposed with the existing landscape. Long-term impacts would result from production facilities, access roads, pipelines, and fugitive dust. When comparing the three alternatives, it was assumed that an equal percentage of wells would be located in the critical I-80, U.S. 30, and U.S. 189 viewsheds. Impacts would be greatest under the Proposed Action because the largest number of wells, roads and pipelines would be associated with this action. Thus the largest area of disturbance would result from implementing the Proposed Action. The Proposed Action would produce significant impacts if all potential well locations were developed in the Class II and Class III zones. Impacts in the Class IV zone would not be significant.

Impacts associated with Alternative A would be substantially lower than those of the Proposed Action. Whether or not these impacts would also be considered would depend upon how many wells would be drilled in Class II and III VRM zones. Any wells drilled in Class II and more than two wells per square mile in Class III would constitute a significant impact unless screened from view.

Impacts associated with the No Action alternative could be less than those of the Proposed Action and Alternative A. Impacts associated with any well site development in Class II areas would be considered significant unless they were screened from view. Impacts in Class III areas would not be considered significant unless well densities exceeded two well sites per square mile.

4.11.5 Cumulative Impacts

To date, 126 wells that have been drilled in the Moxa analysis area are visible from major highways, adjacent recreation areas, and the railroad. The Proposed Action and Alternative A would add substantially to the existing level of impact as described in Chapter 3. Depending on specific site conditions, the 1,325 new well sites proposed under the Proposed Action or 795 under Alternative A could tip the level of contrast from Common Natural/Human Influenced to Human Dominated in the I-80 (Viewshed 7); the U.S. 189 (Viewshed 2) and U.S. 30 (Viewshed 5) would change from Common Natural to Common Natural/Human Influenced. Numerous mineral development projects exist in the immediate region around Moxa Arch. Several projects including Wamsutter, Creston Blue Gap and Whitney Canyon Carter Creek units are visible from I-80, Amtrack, or State highways. Other developments such as Hickey Mountain-Table Mountain, Lincoln Road/Lodgepole, Big Piney, La Barge and Soda Units are in or near popular recreation areas. Other proposed actions in the region would cover an additional five percent of the Wyoming Basin Ecosystem of southwestern Wyoming.

Although these mineral extractive developments are not within the seven Moxa analysis area viewsheds described in Chapter 3, they could be experienced in various combinations by those travelling through or recreating in the region. Collectively existing and proposed projects could affect several million acres. The visual resource on a substantial percentage of these acres have been adversely impacted. The Wyoming Basin Ecosystem could become a landscape where oil and gas facilities are a predominant visual feature in the landscape. The industrial character associated with oil and gas development could become the most memorable impression for those traveling through or recreating in this landscape.

Because of the checkerboard land-ownership pattern within many of the Class II and III areas, development will likely continue on private and State sections without regard to the visual impact.

4.11.6 Mitigation Summary

In addition to mitigation measures detailed in Chapter 2, the following are recommended:

- Prohibit drilling locations, where feasible, in any Class II areas along Fontenelle Reservoir, the Green River, as well as along Seedskadee NWR, and Hams Fork. Restrict drilling locations, where feasible, to locations not visible from a federal, county, or State highway.
- Restrict drilling on all Class III areas visible from the locations noted above to two drill sites per square mile. This would serve to minimize the overall number of contrasting points in the landscape and would minimize contrast in line and form. See Exhibit 3-16.
- Utilize low profile storage tanks. This would also minimize contrast in line and form.

Mitigation measures identified in Chapter 2 would be applied to all federal lands but may not be consistently applied to State and private lands within the analysis area.

4.11.7 Residual Impacts

Impacts including potentially significant impacts within the I-80, U.S. 189, and U.S. 30 viewsheds would persist for the life of the project. Once activities are terminated. compliance with recommended cleanup and reclamation procedures would bring the area into compliance with Class II, III, and IV zone permitted levels of contrast.

No significant residual impacts to the visual resource would occur with implementation of the proposed project given compliance with recommended mitigation measures once the life of the gas field expires. Some short-term contrasts in line, color and texture would remain until vegetation is reestablished.

The commitment to apply mitigation is to federal lands; private and State lands may not have the same level of protective measures. Not implementing mitigation measures on all lands affected could result in increased severity and magnitude of visual impacts.

4.12 NOISE

4.12.1 Introduction

Implementation of the Moxa project has the potential to create noise-generated impacts that emanate from machinery utilized during the construction of the drill sites, pipelines, access roads, and ancillary facilities, and noise generated by the operation of heavy trucks and related equipment.

4.12.2 Resource Management Objectives and Impact Significance Criteria

There are no specific resource management directions presented in the Kemmerer RMP for this resource discipline. The following criteria was used to assess the significance of noise impacts related to this project:

- Long-term activities that would exceed federal 55 decibels (dBA) maximum standards for noise at either residences or other sensitive locations, such as raptor nests, grouse leks, or wildlife crucial ranges.

4.12.3 Direct and Indirect Impacts

4.12.3.1 Proposed Action and Alternative A

Noise associated with construction and natural gas production operations can create a disturbance that affects human safety (at extreme levels) or comfort as well as modifies animal behavior. Determining activities that exceed the maximum standards is not a simple issue since perception of sound varies with intensity and pitch of the source, air density, humidity, wind direction, screening/focusing by topography or vegetation, and distance to the observer. Noise levels in excess of the 55 dBA maximum standards can occur at construction and production operations. Under typical conditions, excess levels decline below the level of significance (55 dBA) at 3,500 feet from the source (USDI-BLM 1991a). Construction-related impacts would occur in the short term, lasting as long as construction activities were on-going at well sites, access roads, pipelines, and other ancillary facilities such as compressor sites. Noise would be created over a longer term at the individual well sites as a resulting of drilling activities.

4.12.3.2 Alternative B - No Action

Implementation of Alternative B (No Action) would add to existing noise levels within the Moxa analysis area during construction of previously authorized activities on federal land and during construction on State and private land as authorized by the WOGCC on a case-by-case basis. Impacts would be similar to those described for Alternative A.

4.12.4 Impacts Summary

Given the low human population densities in the analysis area, construction and development operations under the Proposed Action and Alternative A would be sufficiently distant from residences that none would likely be affected by construction or development operations. Overall noise produced by construction and support services equipment during peak activity periods would be moderate because of its dispersed and short-term nature.

4.12.5 Cumulative Impacts

Continuous noise would result from on-going construction, drilling, and gas production operations during the life of the project. Increased traffic on existing transportation system roads within the analysis area would occur, thus adding to existing traffic noise. However, given the current and anticipated low and dispersed traffic volumes, and dispersed nature of gas production operations within the Moxa analysis area, these projected increases in project-related noise would not be significant.

4.12.6 Mitigation Summary

Measures to mitigate noise impacts would include the following:

- In any area of operations (drill site, compressor site, etc.) where noise levels may exceed federal Occupational Health and Safety Administration (OSHA) safe limits, Moxa Operators would provide and require the use of proper personnel protective equipment by employees.

4.12.7 Residual Impacts

Implementation of mitigation measures as proposed should fully mitigate or reduce all noise impacts to levels not considered significant.

4.13 RECREATION RESOURCES

Well drilling, testing and production operations, and associated site preparation and construction activities such as those proposed for the Moxa analysis area have the potential to cause some major alterations to the recreation setting and recreation opportunities available to persons using the area. Some recreationists could be temporarily or permanently displaced from using certain locations associated with drilling and production activities. Displacement of recreationists could also result from changes in the numbers or distribution patterns of wildlife that attract hunters and wildlife observers to the area.

The presence of construction and drilling equipment and associated increased evidence of human industrial activities in the analysis area could reduce opportunities for recreationists seeking to experience solitude and isolation from human activity. An increase in drilling and production facilities would also cause a safety hazard to those recreationists who continue to hunt in their traditional hunting areas. Such changes could also result in displacement or redistribution of recreationists who would choose to avoid such conditions, as well as reduced satisfaction among others who might continue to engage in recreation activities in the analysis area.

4.13.1 Resource Management Objectives and Impact Significance Criteria

4.13.1.1 Resource Management Objectives

- Management activities will ensure the continued availability of outdoor recreation opportunities sought by the public and which are not readily available from other public or private entities.
- Additional goals include protecting resources, meeting legal requirements for visitors health and safety, and mitigating resource user conflicts involving recreation.

4.13.1.2 Impact Significance Criteria

An impact to the recreation resource would be considered significant if the levels or patterns of project equipment and vehicle use would result in the following:

- displacement of recreation for more than one season of use,
- increased evidence of human activity reducing recreationists perceived levels of isolation/solitude, and/or
- hunters use of the area below WGFD objectives.

4.13.2 Direct and Indirect Impacts

4.13.2.1 Proposed Action

The impact of drilling and construction on the recreation resource under the Proposed Action alternative would involve the temporary displacement of some hunters; particularly during the Pronghorn season when use is highest. Theoretically, many hunters could relocate to other hunting areas within or near the Moxa analysis area. However, the number of proposed mineral extraction activities in the region and the WGFD preset Antelope Hunting Area 93 boundaries would make relocating increasingly difficult over time for hunters seeking solitude and isolation as part of their outdoor experience. In addition, anglers recreating on Fontenelle Reservoir and the Green and Hams Fork rivers could also be adversely impacted if drilling occurs within the viewsheds of these recreation sites.

Short-term impacts associated with drilling activities could also contribute to a deterioration of the experience of non-consumptive backcountry recreationists who may continue to use the area. These impacts would be most pronounced if drilling activities were scattered throughout the field during the ten-year planning period.

Overall, these impacts would not be considered significant at any one drilling site due to the short-term nature of project activities. However, when considering the increased level of activity within the entire 748 square-mile Moxa Arch Field, there could be a deterioration in the quality of the recreation experience throughout the year 2005.

Production and storage facilities would remain once drilling was completed. The visible presence of these facilities and activities could have a negative impact on some hunters and backcountry users. These impacts would be similar to those discussed as short-term impacts and could lead to user displacement. Increasingly limited opportunities for recreationists to relocate into suitable nearby areas would increase the potential for recreationist dissatisfaction.

As noted in Chapter 3, the improved access to backcountry locations associated with an increase in road density could attract a larger proportion of hunters that prefer easier access to the Moxa analysis area, however there would be the safety hazard of more drill sites and production facilities and firearms during hunting season. Impacts described above would persist for the life of the project.

4.13.2.2 Alternative A

Both short-term and long-term impacts associated with Alternative A would be the same as those described for the Proposed Action. However, because of the reduced well density of Alternative A, the perceived impact would be somewhat lower. Displacement of recreationists would likely continue at levels similar to those described under the Proposed Action.

4.13.2.3 Alternative B - No Action

Implementation of the No Action alternative would result in the continuation of existing recreation and activity patterns in the Moxa analysis area. A gradual deterioration in the quality of the recreation experience over time could be expected as the number of wells increases (approved one well site at a time).

4.13.3 Impacts Summary

Neither the Proposed Action nor the No Action alternative would have significant adverse impacts on recreation resources given measures in Chapter 2 (particularly Visual Resource Mitigation) and the RMP (USDI-BLM 1986) stipulations.

4.13.4 Cumulative Impacts

Numerous mineral development projects exist in the immediate region around the Moxa analysis area. A number of other development actions involving an estimated one million plus acres are proposed. Most of the proposed developments (e.g., as Lincoln Road) would occur in pronghorn habitat. The potential disturbance associated with these proposed actions could further displace recreationists, particularly hunters, using the area. Development of these projects would limit the ability of hunters and other recreationists to relocate their activities in suitable environments nearby. These conditions would increase the probability of recreationist displacement and dissatisfaction as well as a safety hazard during hunting season.

4.13.5 Mitigation Summary

Given the measures proposed by the proponents (Chapter 2) and those listed for Visual Resources, no additional mitigation measures would be required. Identified measures, however, may not be consistently applied to non-federal lands.

4.13.6 Residual Impacts

Given the measures incorporated into the project, no residual impacts are anticipated. If measures are not consistently applied for all lands in the analysis area, resultant impacts could be of greater magnitude than identified in this EIS.

4.14 SOCIOECONOMICS

4.14.1 Introduction

Implementation of the Proposed Action has the potential to create primarily positive socioeconomic impacts that could offer: 1) continued levels of employment in the regional oil and gas industry, 2) economic benefits in other sectors of the regional economy stemming from employee and industry spending, and 3) a source for generating additional tax revenues.

4.14.2 Resource Management Objectives and Impact Significance Criteria

There are no specific RMP directions presented for this resource discipline. The following criteria were used to determine whether socioeconomic impacts of the Proposed Action would be significant:

- demographic impacts involving a greater than ten percent annual increase in a local area population. This criteria is based on the assumption that such growth would strain the ability of affected communities to provide housing and services or otherwise adapt to growth-related social and economic changes;

- an aggregate change in revenue and expenditure flows likely to result in an inability on the part of affected units of government to maintain public services and facilities at established service level standards; and
- any permanent displacement of residents or users of affected areas, identifiable changes in or conflicts with existing ways of life, or levels of dissatisfaction likely to generate organizational response and conflict.

4.14.3 Indirect and Indirect Impacts

4.14.3.1 Proposed Action

Local Economy. As shown by Exhibit 4-7, approval of the Proposed Action would essentially continue the level of drilling and well field development activity which has occurred in the Moxa analysis area since 1991. As described in Section 3.14.2, the regional oil and gas service industry has expanded to accommodate recent levels of infill during drilling and field development activity in the analysis area and other natural gas fields within the three-county region. Consequently, it is anticipated that the existing oil and gas service industry within the analysis area would be able to accommodate the activities contemplated in the Proposed Action without an increase in work force. Conversely, the infill drilling and field development activities contemplated under the Proposed Action would provide continued employment for a portion of the regional oil and gas service industry yielding associated regional economic benefits.

Population, Housing and Local Government Facilities and Services. Because Proposed Action-related drilling and field development activities would be accommodated by the exiting regional oil and gas service industry, no population effects are anticipated within the analysis area. Similarly, no new demand for area housing or local government facilities and services is anticipated.

Local Government Fiscal Conditions. Local governments within the analysis area are not anticipated to experience any Proposed Action-related demand on local government facilities and services and, therefore, would not incur additional costs (with the exception of transportation-related costs discussed in Section 4.3). Consequently, this section focuses the projection of tax revenues stemming from Proposed Action-related activities. The projected tax revenues presented in this section are in 1994 dollars.

Sales and Use Tax . Sales and use tax projections are based on the assumption that Operators and their subcontractors have or would obtain Lincoln, Sweetwater and Uinta county sales and use tax licenses for all purchases made in connection with the Proposed Action, as prescribed by Wyoming statutes. The Operators would pay sales and use taxes on the purchase of non-exempt equipment materials and supplies used for drilling, pipeline and road construction, and construction of production facilities.

Purchases of goods for use within the State of Wyoming are subject to sales and use tax, which is paid to the Wyoming Department of Revenue and Taxation. The State returns 28 percent of the four percent statutory sales and use tax to the county of origin. The portion returned is distributed to the county and the incorporated cities and towns within the county according to a formula based on the most recent decennial census population. Revenues from an optional one percent county sales and use tax, which each of the three counties currently have in place, are distributed among the county and the incorporated cities and towns in the same manner. The distribution rates for Lincoln, Sweetwater and Uinta counties are illustrated in Table 4-14.

The average tangible costs for equipment associated with the drilling of each well are estimated to be $247,000. This would be a total of approximately $327 million for 1,325 wells over ten years. These expenses would generate about $16.36 million in State and local sales and use tax revenue. Of this total, $2.8 million would be distributed to Lincoln County, $2.5 million to Sweetwater, and $1.7 million to Uinta County. The State share of sales and use tax revenue over ten years would be about $9.4 million.

The average tangible costs associated with the installation of pipeline for each well are estimated at $14,097 (for an average of 1.1 mile of pipeline per well). This would be a total of approximately $18.68

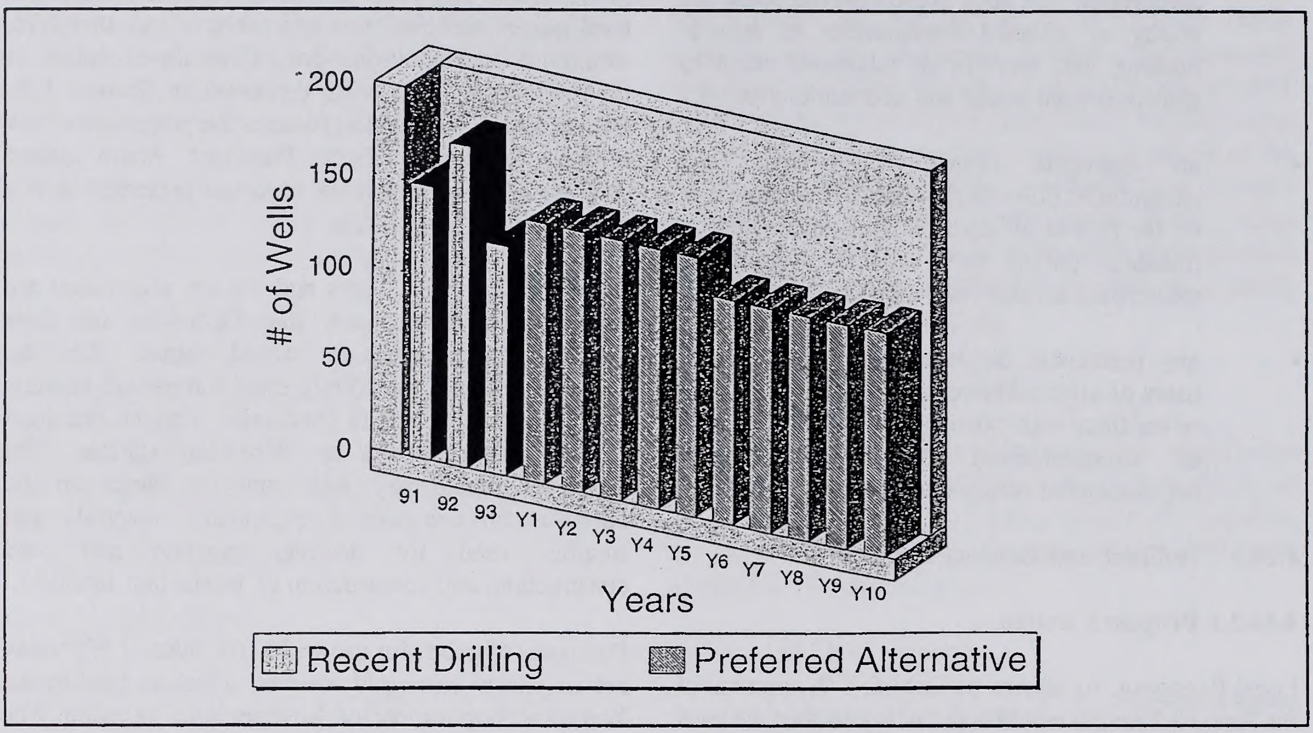

Exhibit 4-7. Historical and Proposed Action-Related Drilling Activity.

million for 1,325 wells over ten years. These expenses would generate about $933,926 million in State and local sales and use tax revenue. Of this total, $158,391 would be distributed to Lincoln County, $141,954 to Sweetwater, and $95,632 to Uinta. The State share of sales and use tax revenue over ten years would be about $537,949.

State Severance Tax. The State of Wyoming collects a severance tax on gross revenues from gas production. The tax rate on natural gas production is six percent. Any State or federal mineral royalties paid may be deducted from gross revenues before applying the severance tax. The estimated State severance tax revenues generated by the Proposed Action would range from about $1.5 million in 1995 to $25.2 million in 2004. These estimates are based on production volumes provided in Chapter 2. Prices used for these projections were provided by the Wyoming Consensus Revenue Estimating Group for 1995 to 1997. The 1997 price of $2.34 per thousand cubic feet (MCF) was used for the period from 1997 through 2004 and a decline in production per well of seven percent per year was assumed to begin after five years.

Annual estimates for the State severance tax and State and federal mineral royalties are provided in Table 4-15. Of the State severance taxes collected on oil and gas production, 0.75 percent is distributed to cities and towns and 0.25 percent is distributed to counties on the basis of population. State severance tax revenues also provide funding for State highways, water development, the School Foundation Program, community colleges and general State government.

Mineral Royalties. The State of Wyoming and the federal government require payment of royalties for production of oil and gas on State- and federal-owned lands. The State and federal royalties for gas production are generally 12.5 percent of gross revenue. Approximately 55 percent of the land within the analysis area is under federal ownership and 2.8 percent is State land. Estimated annual State and federal natural gas royalties are illustrated in Table 4-15. These projections are based on similar assumptions regarding prices and production as the preceding severance tax projections.

Table 4-14. Direct Project-Related Sales and Use Tax Revenues Over the Ten-Year Drilling Program.

Local Government	Distribution Percentage	Estimated Project Sales and Use Revenue
Lincoln County	**45.96**	**1,348,321**
Afton	11.04	323,879
Alpine	1.58	46,352
Cokeville	3.9	114,414
Diamondville	6.84	200,664
Kemmerer	23.92	701,737
La Barge	3.9	114,414
Opal	0.75	22,003
Thayne	2.11	61,901
TOTAL Lincoln County	**100**	**2,933,683**
Sweetwater County	**15.96**	**419,627**
Bairoil	0.59	15,513
Granger	0.32	8,414
Green River	32.74	860,814
Rock Springs	49.07	1,290,170
South Superior	0.7	18,405
Wamsutter	0.62	16,301
TOTAL Sweetwater County	**100**	**2,629,244**
Uinta County	**25.21**	**446,540**
Evanston	58.29	1,032,479
Lyman	10.14	179,608
Mountain View	6.36	112,653
TOTAL Uinta County	**100**	**1,771,280**

Source: PIC Estimates.

About half of the federal mineral royalties collected within Wyoming are returned to the State. Of the amount received, 9.375 percent is distributed to cities and towns on the basis of population and 0.625 percent is distributed to counties based on population. An additional 4.5 percent of the State's share of federal mineral royalties are distributed to counties for construction and maintenance of county roads.

Table 4-15. State of Wyoming Severance Tax and State and Federal Mineral Royalty Revenue.

Year	Wyoming Severance Tax	Wyoming Mineral Royalties	Federal Mineral Royalties
1996	2,981,784	406,238	4,062,377
1997	9,386,604	1,278,829	12,788,288
1997	15,644,340	2,131,381	21,313,814
1999	21,902,075	2,983,934	29,839,340
2000	28,859,811	3,836,487	38,364,865
2001	32,815,113	4,470,724	44,707,239
2002	37,032,374	5,045,283	50,452,825
2003	40,811,593	5,560,162	55,601,625
2004	44,152,770	6,015,364	60,153,638
2005	47,055,906	6,410,886	64,108,864
Project TOTALS	**279,942,370**	**38,139,288**	**381,392,875**

Source: PIC Estimates (1994 dollars); totals may not add due to rounding.

Distribution of State Mineral Royalties Varies between Leases. They are normally allocated among various institutions and funds such as the University of Wyoming, Wyoming State Penitentiary, Wyoming State Library and the Wyoming Common School Fund. None of these funds are returned to cities or counties.

County Ad Valorem Property Taxes on Facilities. Lincoln, Sweetwater and Uinta counties would levy property taxes on surface facilities and on the value of gas production from the Proposed Action. All revenues presented in this section are projected using 1993 mill levies. Mill levies are set each year, higher or lower mill levies would correspondingly alter these projections. Wells in Lincoln County are assumed to be located in Tax District 100 which had a total levy of 55.250 mills in 1993. In Sweetwater County, wells are assumed to be in Tax District 102 which had a total 1993 levy of 70.068 mills. Wells in Uinta County are assumed to be located in Tax District 106 which had a total levy of 71.881 mills in 1993.

In Wyoming, the value of industrial property is assessed as of February 1. All surface facilities such as compressors, well head equipment, tank batteries and pipelines would be assessed as industrial property at 11.5 percent of actual value. Taxable property in Lincoln County would be the surface facilities associated with 530 wells. In Sweetwater County, taxable property would include the surface facilities associated with 475 wells. Taxable property in Uinta County would be the surface facilities associated with 320 wells.

This analysis assumes that an average of 1.1 miles of pipeline would be required for each new well. It also assumes that 86 percent of wells drilled would be producers. The average assessed values for well head equipment, tank batteries, compressors and pipelines are based on figures provided by Amoco and Williams Field Services.

Ad valorem property taxes on facilities would begin in 1996 and continue throughout the life of the project. Based on the foregoing assumptions, over the ten years of the drilling program, taxing entities in Lincoln County would receive an estimated $730,912. Sweetwater County taxing entities would receive an estimated total of approximately $818,235. Taxing entities in Uinta County would receive an estimated total of about $563,615 over ten years.

County Ad Valorem Property Taxes on Production. The value of gas production for property tax purposes is the value of gas sales from the previous calendar year minus State and federal royalties paid. Property taxes on production are assumed to begin in 1996 and continue throughout the life of the project. Based on the foregoing assumptions, over the ten years of the drilling program, the Lincoln County General Fund would receive an estimated total of approximately $15.6 million. The General Fund in Sweetwater County would receive an estimated total of about $12.8 million. Estimated total Uinta County General Fund property taxes on production would be approximately $8.2 million. Projected County General Fund ad valorem tax revenues are presented in Table 4-16.

The total ad valorem property and production taxes projected for each county are shown in Table 4-17. The ad valorem levy in each county consists of levies assessed by a number of taxing districts in each county. Consequently, the revenues derived from the total levy are distributed among the various taxing entities. Mill levies for each of the taxing entities of the three counties are illustrated in Table 4-18.

It should be noted that the school districts identified in Table 4-18 may not receive the additional ad valorem revenue indicated. This is due to the funding formula of the Wyoming School Foundation Program.

Revenue Impacts Summary. Each of the counties and communities in the impact area would receive substantial revenues from the Proposed Action. The largest estimated percentage increases in county general fund revenues would be in Lincoln County. The estimated additional ad valorem revenues generated by the Proposed Action represent a 5.8 percent increase in 1996 and an 18.2 percent increase in 1997 over 1993 ad valorem revenues for Lincoln County. The estimated annual increase in sales and use tax revenues for each of the first five years of the project represent an 11.7 percent increase over 1993 sales and use tax revenues for Lincoln County.

In Sweetwater County, the estimated increases in county ad valorem tax revenues represent a 1.6 percent increase in 1996 and a 5.1 percent increase in 1997 over 1993 ad valorem revenues. The estimated annual increase in sales and use tax revenues for each of the first five years of the project would generate a 2.1 percent increase in Sweetwater County sales and use tax revenues over the 1993 level.

Uinta County is expected to receive an increase in ad valorem tax revenues of 1.9 percent in 1996 and 5.8 percent in 1997 above the 1993 level. The annual estimated increase in sales and use tax revenues over the first five years of the project represents a 3.8 percent increase from 1993 Uinta County sales and use tax revenues. The ad valorem revenue increases would be more significant for each county in later years as more wells are drilled and begin production.

4.14.3.2 Alternative A

Implementation of Alternative A would result in similar socioeconomic impacts as described for the Proposed Action. The number of local drilling, service and operations workers employed in the area would be reduced.

Tax revenues for federal, State and local governments would be reduced due to the reduction in the number of wells drilled and the associated reduction in facilities and production of natural gas. The estimated reduction in sales and use tax revenues for each jurisdiction (compared to the Proposed Action) would be: Lincoln County (-29 percent), Sweetwater County (-48 percent), Uinta County (-45 percent), and the State of Wyoming (-40 percent).

This alternative would also reduce the amount of State severance tax revenues, State and federal mineral royalties and ad valorem revenues (compared to the Proposed Action). The estimated reduction in Wyoming severance tax revenue and State and federal mineral royalties would be about 41 percent. The estimated reduction in total ad valorem tax revenues for each taxing entity in the three counties would be: Lincoln County (-30 percent); Sweetwater County (-51 percent); and Uinta County (-47 percent).

4.14.3.3 Alternative B - No Action

Unless other, unanticipated oil and gas development occurs within southwest Wyoming, implementation of Alternative B (No Action), would likely result in a reduction in employment in the oil and gas sector of the regional economy. A reduction in the area population

Table 4-16. **Annual Ad Valorem Property and Production Taxes (County General Fund Revenues Only).**

Year	Lincoln County		Sweetwater County		Uinta County	
	Production	**Facilities**	**Production**	**Facilities**	**Production**	**Facilities**
1996	167,891	2,319	135,317	1,891	87,211	1,826
1997	528,516	4,737	425,977	3,895	274,538	3,533
1998	880,861	6,748	709,961	5,533	457,563	5,465
1999	1,233,205	8,895	993,945	7,316	640,588	6,936
2000	1,585,549	10,901	1,277,930	8,746	823,618	8,333
2001	1,839,528	12,143	1,495,590	10,145	961,759	9,759
2002	2,068,843	13,570	1,693,372	11,217	1,087,093	10,756
2003	2,273,493	14,653	1,871,275	12,470	1,199,615	11,710
2004	2,543,480	15,931	2,029,298	13,405	1,299,326	12,937
2005	2,608,802	16,876	2,167,443	14,530	1,386,224	13,748
Project Totals	**15,640,167**	**106,773**	**12,800,109**	**89,148**	**8,217,529**	**85,003**

Source: PIC estimates based on 1993 mill levies.

Table 4-17. **Annual Ad Valorem Property and Production Taxes (Total Ad Valorem Revenues).**

Year	Lincoln County		Sweetwater County		Uinta County	
	Production	**Facilities**	**Production**	**Facilities**	**Production**	**Facilities**
1996	1,149,294	15,874	1,241,999	17,354	578,248	12,106
1997	3,617,957	32,429	3,909,789	35,753	1,820,316	23,426
1998	6,029,928	46,195	6,516,315	50,783	3,033,860	36,238
1999	8,441,899	60,890	9,122,842	67,150	4,247,403	45,989
2000	10,853,871	74,623	11,729,368	80,272	5,460,947	55,241
2001	12,592,482	83,125	13,727,145	93,119	6,376,920	64,705
2002	14,162,254	92,891	15,542,466	102,950	7,207,944	71,318
2003	15,563,189	100,304	17,175,330	114,456	7,954,021	77,645
2004	16,795,286	109,059	18,625,737	123,032	8,615,149	85,780
2005	17,858,545	115,524	19,893,687	133,365	9,191,329	91,158
Project Totals	**107,064,706**	**730,914**	**117,484,678**	**818,234**	**54,486,137**	**563,616**

Source: PIC estimates based on 1993 mill levies.

Table 4-18. Total Project Ad Valorem Revenues by Taxing Entity (Ten-year Drilling Program).

Taxing Entity	Mill Levy	Total Project Revenue
Lincoln County	**8.071**	**15,746,940**
School Foundation Program	12.000	23,412,623
School District #1	33.000	64,384,713
County Library	1.085	2,116,894
County Fair	0.562	1,096,492
Weed & Pest Control	0.532	1,037,960
TOTAL Lincoln County	**55.250**	**107,795,622**
Sweetwater County	7.634	12,889,257
School Foundation Program	12.000	20,260,818
School District #2	33.000	56,561,449
SD#2 Bonds & Interest	2.361	3,986,316
Community College	10.116	17,079,869
County Library	1.719	2,902,362
Public Health	0.545	920,179
Museum	0.123	207,673
County Fair	1.260	2,127,386
Recreation	0.405	683,803
Hospital	0.272	459,245
Weed & Pest Control	0.133	224,557
TOTAL Sweetwater County	**70.068**	**118,302,914**
Uinta County	**10.841**	**8,302,533**
School Foundation Program	12.000	9,190,148
School District #6	35.500	27,187,521
SD#6 Bonds & Interest	12.000	9,190,148
County Library	1.000	765,846
County Fair	0.159	121,769
Weed & Pest Control	0.381	291,787
TOTAL Uinta County	**71.881**	**55,049,752**

Source: PIC projections; 1993 mill levies from Wyoming Taxpayers Association.

would also be likely. The various sales and use tax, severance tax, mineral royalty, and ad valorem tax revenues associated with the Proposed Action and Alternative A would not occur. The decline in Uinta County assessed valuation would likely continue.

4.14.4 Impacts Summary

The Proposed Action would provide continued employment for local residents currently employed in the oil and gas drilling and field service industry. This sector of the regional economy has been growing for the past four or five years in response to increasing natural gas well field development activity in southwestern Wyoming. It is anticipated that the existing industry would be able to accommodate the Proposed Action based on past and current levels of oil and gas drilling and production activity and observed employment trends in the region.

Since no in-migrant population is expected to result from the Proposed Action, no impact on local housing conditions is anticipated. The Proposed Action is also not anticipated to place additional demands on local government facilities or services. Additional tax revenues generated by the Proposed Action are anticipated to be substantial. Therefore, potential socioeconomic impacts associated with the Proposed Action are largely positive and not significant according to the thresholds used for this analysis.

4.14.5 Cumulative Impacts

Currently, a variety of industrial development activities are planned for or are under development in the three-county region, including the following:

- Wold Benetron Project;
- FMC Mine Water Soda Ash Expansion;
- Rhone Poulenc Tailings Project;
- Altamont Pipeline;
- Big Piney/La Barge CAP
- Fontenelle/Lincoln Road Natural Gas Project
- Stagecoach Natural Gas Project
- Creston/Blue Gap Natural Gas Project
- Wamsutter Drilling Program Phase II; and
- other natural gas drilling and exploration.

The Wold Benetron, FMC Mine Water Soda Ash Expansion and Rhone Poulenc Tailings Project, are all trona mining and/or soda ash processing expansion or development projects located in southwestern Sweetwater County. These projects are anticipated to strain housing resources and certain local government facilities and services (e.g., Green River High School) in the cities of Green River and Rock Springs during the 1996 calendar year. Wold Trona Company has agreed to provide housing resources for its construction work force, as needed, and a substantial amount of project-related sales and use tax revenues and Wyoming Impact Assistance Payments are anticipated to be available to fund additional local government facility and service needs. Because no population effects are anticipated, cumulative socioeconomic effects are not anticipated to occur with the Proposed Action.

The construction schedule for the Altamont pipeline is uncertain at this time, consequently, it is currently not possible to estimate cumulative effects associated with this proposed project.

Potential population and housing impacts caused by the Wamsutter and Creston/Blue Gap Projects would likely be experienced in the eastern Sweetwater County community of Wamsutter and the Carbon County communities of Rawlins, Sinclair and Baggs and would therefore not affect these conditions within the analysis area for the Proposed Action. Potential housing or population impacts associated with the Big Piney/La Barge project have probably already occurred in the Big Piney, Marbleton, La Barge, Kemmerer and Pinedale areas. Like the Proposed Action, the Fontenelle/Lincoln Road and Stagecoach well field development projects would likely be accommodated by the existing oil and gas service industry and therefore are not anticipated to generate significant population impacts within the analysis area.

The Wamsutter II and Creston/Blue Gap projects would primarily utilize the drilling and field service industry located in Casper, Rawlins and Wamsutter. The Big Piney/La Barge, Fontenelle/Lincoln Road, and Stagecoach projects would draw from the drilling and field service industry in Sublette, Lincoln, Sweetwater and Uinta counties.

The anticipated drilling programs for all of the projects identified in Table 4-19 would approach the level of activity that existed in the three counties in 1992. However, only five of the proposed 275 wells of the Creston/Blue Gap project and 563 of the proposed 750 wells of the Wamsutter II project are located in

Table 4-19. Anticipated Drilling Programs for all Projects Near the Moxa Analysis Area.

Project Name	Total Number of wells (Over Ten Years)	Estimated Number of Wells Drilled Per Year
Moxa Arch Infill	1,325	142
Big Piney/La Barge Infill	600	80
Fontenelle/Lincoln Road Development	1,317	195
Stagecoach	66	7
Wamsutter Phase II	750	75
Creston Blue Gap	275	85
TOTALS	**4,333**	**584**

Source: USDI-BLM.

Sweetwater County. The primary impacts of the Creston/Blue Gap and Wamsutter projects would be experienced in Carbon County and extreme eastern Sweetwater County.

4.14.6 Mitigation Summary

No negative socioeconomic impacts are anticipated to be associated with the Proposed Action or alternatives. The anticipated revenues associated with the Proposed Action would provide substantial revenues to local governments within the analysis area which would provide funding for mitigation for unanticipated project-related impacts to local government facilities and services.

4.14.7 Residual Impacts

The revenue stream associated with the Proposed Action would continue to flow for the life of the project, barring substantial changes in Wyoming tax structure. Employment would be provided for local well drilling workers through the ten-year drilling program and for oil and gas field service workers in the area for the life of the project.

4.15 CULTURAL RESOURCES

4.15.1 Introduction

The Moxa analysis area cultural resource database includes 2,994 sites, consisting of both prehistoric and historic components. The population of known prehistoric sites in the analysis area (n=2,870) consists mostly of open camps and lithic scatters. Within the prehistoric site population, 678 sites are recognized as eligible for the National Register of Historic Places (NRHP) (122 with State Historic Preservation Office [SHPO] concurrence) and 1,572 sites are not eligible for the National Register (two with SHPO concurrence). Three prehistoric sites are enrolled on the Register. Insufficient information is available for 614 sites to allow the National Register status to be determined. Three sites have been destroyed.

Known historic site types within the analysis area include stockherding sites, trails/highways, ranches, railroad sites, and urban sites. From the population of recorded historic sites (n=238) within the analysis area, 58 sites have been evaluated as eligible for nomination to the National Register (seven with SHPO concurrence) and 112 are not eligible for nomination to the Register. Three historic sites are on the Register. Finally, 65 sites have not been evaluated for National Register status because of insufficient information.

4.15.1.1 Native American Consultation

The BLM, Rock Springs District, has conducted the Native American consultation, in accordance with Section 4(c) of the Archaeological Resources Protection Act (16 U.S.C.C) and Section 43 CFR 7.7(b)(1). Native American cultural groups that may have a historical interest in the area were contacted to convey to the

BLM any questions and/or concerns they may have regarding the Moxa analysis area. The BLM has not received any communication from the cultural groups involved.

4.15.2 Resource Management Objectives and Impact Significance Criteria

4.15.2.1 Resource Management Objectives

- For most surface-disturbing activities, an inventory to locate and evaluate cultural resources (including historic and prehistoric sites) will be performed. If potential impacts to significant cultural resources are identified, the preferred strategy will be to avoid the cultural site. When avoidance is not feasible, other mitigation strategies will be used.
- Surface disturbance will be prohibited within either one-quarter mile or the visual horizon (whichever is closer) of historic trails.

4.15.2.2 Impact Significance Criteria

Impacts would be significant if any information was lost that impeded efforts to reconstruct the prehistory or history of the region.

Assessment of Site Significance

Mitigation of potential adverse effects is afforded to properties considered to be eligible for nomination to or listed on the NRHP. Site significance, and therefore National Register eligibility, is measured by criteria established by the National Register. The National Register criteria (36 CFR 60.4) define four categories with which to measure significance based on "the quality of significance in American history, architecture, archeology, and culture present in districts, sites, buildings, structures and objects of State and local importance that possess integrity of location, design, setting, materials, workmanship, feeling, and association; and that:

- are associated with events that have made a significant contribution to the broad patterns of our history; or
- are associated with the lives of persons significant in our past; or
- embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
- have yielded, or may be likely to yield information important in prehistory or history.

For prehistoric and historic archaeological sites, significance is primarily judged by a site's potential to yield data important to prehistory or history (i.e., significance is based on information content and how that information would contribute to addressing local and regional research questions).

ACHP Criteria to Assess Effects

The BLM uses the criteria in the Advisory Council for Historic Preservation's (ACHP) regulations (36 CFR 800.9) to assess effects to sites which are eligible for the National Register. Adverse effects would occur under the following circumstances:

- Destruction or alteration of all or part of a property.
- Isolation of a cultural resource from, or alteration of, its surrounding environment.
- Introduction of visual, audible, or atmospheric elements that are out of character with the property or will alter its setting.
- Neglect and subsequent deterioration.

4.15.3 Direct and Indirect Impacts

4.15.3.1 Proposed Action

Adverse effects to cultural resources under the Proposed Action could be in the form of direct, indirect, or cumulative impacts. Direct impacts to sites considered eligible for the NRHP would primarily result from construction-related activities. Activities that are considered to have the greatest effect on cultural resources would be the blading of well pads and associated facilities, construction of roads, pipelines, and related facilities. Alteration of the environment surrounding historic properties that are eligible to the

National Register under Criteria a, b, or c may be considered an adverse effect and, therefore, a direct impact on the property.

Sites that are located outside the area of potential effect would not likely be directly affected by construction-related activities. Additionally, if the portion of the site crossed by earth-disturbing activity does not possess the qualities that make the site eligible, the project is judged to have no effect on the site. Impacts to cultural resources would need to be mitigated for those eligible sites that fall within the area of potential effect and to which the impact would result in information loss.

Indirect impacts would not immediately result in the physical alteration of the property. Indirect impacts to prehistoric sites primarily would result from unauthorized collecting of artifacts which would physically alter the site. With regard to historic sites, indirect impacts would result from surface artifact collecting, bottle prospecting, and alteration of the surrounding environment by introducing visual impacts. These effects could be cumulative if they persisted through time and incrementally resulted in the deterioration of the property.

Historic trails would be avoided by Moxa Operators on federal and private lands (subject to landowner preference or agreement) as necessary during construction. General visual intrusion and surface disturbance associated with proposed construction and development activities would be restricted or prohibited within 0.25 mile or within the visual horizon, whichever is closer, to provide a protective corridor for historic trails within the analysis area.

4.15.3.2 Alternative A

Impacts associated with Alternative A would be similar, but of less magnitude, than those described for the Proposed Action.

4.15.3.3 Alternative B - No Action

As a result of Alternative B (No Action), this project would not affect or increase the potential for impacts to cultural resources within the Moxa analysis area. However, the potential for impacts would continue as well sites are completed within the analysis area.

4.15.4 Impacts Summary

Gaging the effect of any development-related impact depends on the level of information available for each particular cultural property provided by inventory and/or testing data. If the BLM determines that cultural resources on or eligible for the National Register are to be adversely impacted by a proposed undertaking, the BLM, in consultation with SHPO and the Moxa Operators, shall develop a mitigation plan. Typically, construction does not proceed until terms of the mitigation plan are satisfied.

Potential impacts to specific eligible or unevaluated properties are unknown at this time. In general, the Moxa analysis area has a moderate to high site density and, therefore, high archaeological sensitivity. Certain geomorphic situations have a greater archaeological potential than other areas especially in terms of significant cultural resources. These situations include eolian deposits (sand dunes, sand shadows and sand sheets), alluvial deposits along major drainages, and colluvial deposits.

Although the analysis area has a high degree of archaeological sensitivity, impacts to cultural properties would not be significant. Potential impacts to known and anticipated cultural resources can be alleviated through appropriate mitigation measures.

4.15.5 Cumulative Impacts

Disturbance and/or loss of other unidentified sites or artifacts could add to the cumulative loss of information about our heritage in the analysis area and in the region if these sites or resources are not identified and inventoried prior to disturbance. Any loss or damage to unidentified cultural or historical sites or resources associated with the proposed natural gas development project, combined with similar losses or damage due to natural gas development projects or other developments near the analysis area, could be substantial. The implementation of Class III pedestrian inventory on all proposed drill sites, access roads, and pipeline corridors would minimize the potential for cumulative impacts to cultural resources in the analysis area.

4.15.6 Mitigation Summary

No additional measures beyond those provided in Chapter 2 (Section 2.2.4.2.15, Cultural Resources) and management direction contained in the RMP would be required to minimize adverse impacts to cultural and historic resources. However, such measures may not be consistently applied on private lands.

Because of the extent of existing energy development, the scope of proposed development, and the amount of previous archaeological work within the Moxa analysis area, a programmatic agreement will be prepared between Moxa Operators, the BLM, SHPO, and ACHP to delineate the process of managing cultural resources within the analysis area. A document synthesizing the extant database is currently being generated to identify the status of previous archaeological work in the area. This synthetic document is focusing on the results of excavation and tested sites. The evolution of the criteria utilized to select sites for data recovery is of particular interest. Special emphasis is being placed on refining the Wyoming Basin cultural chronology in light of recent investigations concerning housepits, pottery, settlement and subsistence patterns, and rock art dating. Additionally, innovative techniques for fieldwork and interpretation will be evaluated.

4.15.7 Residual Impacts

By avoiding known cultural and historical sites during drilling facility layout (drill sites, access roads, and pipeline corridors), and by implementing Class III inventory on the proposed project elements (drill sites, access roads, and pipeline corridors), the potential for adverse impacts to cultural resources in the analysis area is minimized. With consistent implementation of these measures on all lands (i.e., federal, State, and private), there would be no avoidable impacts to cultural resources in the analysis area. If implementation is not consistent, the magnitude of impacts to cultural resources would be greater than described in this EIS.

4.16 HEALTH AND SAFETY

4.16.1 Introduction

Potential risks associated with the Proposed Action include the normal risks associated with traffic, heavy construction and drilling operations. As described in Air Quality, H_2S is not present within the Moxa analysis area and therefore is not a safety concern for this area.

4.16.2 Resource Management Objectives and Impact Significance Criteria

No specific health and safety standards were identified in the Kemmerer RMP. The following criteria were used to determine the degree of impacts relative to health and safety aspects of the natural gas production proposal:

- Increased risk to the public caused by project implementation.

4.16.3 Direct and Indirect Impacts

4.16.3.1 Proposed Action

During 1992, the oil and gas industry in Wyoming experienced an overall incidence rate of 8.3 injuries and illnesses per 100 workers (U.S. Department of Labor, Bureau of Labor Statistics, April 1994). During 1992, a total of 12,100 workdays were lost in the oil and gas extraction industry. Of this total, 2,600 days were lost in the area of crude petroleum and natural gas production, with the remaining 9,500 lost workdays occurring in the oil and gas field services area. Injury and illness lost workdays occurring in the oil and gas extraction industry were almost twice the rate of similar fields in the mining industry. These potential risks associated with the oil and gas extraction industry would be limited to employees and subcontractors and would not affect the public.

Short-term health and safety impacts could occur during the maintenance and construction of the road system, with possibly some effect on the existing public traffic. The increase in traffic volume would have a tendency to increase accidents during construction and drilling operations. With completion of the initial phases of the drilling and production operations, there would be minimal long-term health and safety impacts other than those associated with service vehicles providing support and maintenance operations.

4.16.3.2 Alternative A

Impacts from road, drill site, and pipeline construction; drilling operations; production operations; and project traffic would be similar to those described under the Proposed Action, with the exception of fewer hazards imposed by a smaller drilling and production operation.

4.16.3.3 Alternative B - No Action

Health and safety issues within the analysis area would remain essentially as described in the Affected Environment although additional well development would occur as APDs were approved by the BLM and/or the WOGCC on a case-by-case basis.

4.16.4 Impacts Summary

Hazards associated with the drilling program, including construction and operation, are the ones normally associated with heavy construction and industrial work. There would be a minor increased risk to the public caused by project implementation resulting from additional drilling and production related traffic in the analysis area. None of these impacts occur at significant levels.

4.16.5 Cumulative Impacts

Because the probability of risk to public health and safety resulting from implementation of the Proposed Action and Alternatives A and B would be low, no cumulative impacts are expected.

4.16.6 Mitigation Summary

As no potentially significant impacts would occur, there is no need for additional mitigation measures beyond measures presented in Chapter 2.

4.16.7 Residual Impacts

No residual impacts to public health and safety are expected to result with implementation of either the Proposed Action or Alternatives A and B.

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CHAPTER 5

MITIGATION AND MONITORING

CHAPTER 5

MITIGATION AND MONITORING

5.0 INTRODUCTION

Mitigation and monitoring measures describe how Moxa project activities should be implemented to assure compliance with resource management goals and objectives provided in the Record of Decision (ROD) for the Kemmerer Resource Management Plan (RMP) (USDI-BLM 1986); other approvals applicable to the analysis area such as the Amoco Production Company Moxa Arch Natural Gas Production Project MAEA/DR (USDI-BLM 1991a); the Moxa Arch Supplemental EA (USDI-BLM 1992a); and applicable lease stipulations within the Moxa analysis area. The mitigation and monitoring measures deemed applicable to the Moxa project are identified in Chapters 2 and 4. These measures, coupled with the principles and guidelines provided in Appendices A and B, are believed to provide all practicable means of avoiding or minimizing environmental harm and unnecessary or undue degradation of the land.

Because of the checkerboard land pattern, the BLM is limited to requiring the identified measures to federal surface and mineral estate. The project-wide mitigation measures presented in Chapter 2 (Section 2.2.4) are proposed by the Moxa Operators to avoid or mitigate resource or land use impacts on federal surface within the Moxa analysis area. These mitigation measures would be applied on privately owned surface and State of Wyoming lands if specified by the involved private and/or State surface owners.

5.1 MITIGATION

The mitigation measures and monitoring opportunities identified in Chapter 4, Environmental Consequences, have been developed in response to impacts identified through analysis of the proposed action and alternatives. Each mitigation measure defines an action that could be taken to minimize impacts identified in Chapter 4 on federal, State and privately owned lands within the Moxa analysis area. They describe construction, drilling, operation and maintenance, and reclamation measures that could be implemented to assure reduction or elimination of adverse impacts identified during the interdisciplinary analysis. The listed mitigation measures provided in Chapter 2 and Chapter 4 could be added to, modified, or selectively withheld by the Authorized Officer (AO), based on site-specific information gathered during the on-site review of an application for permit to drill (APD) or right-of-way (ROW).

Following public input, the Record of Decision (ROD) that the BLM will issue on the Expanded Moxa Arch Natural Gas Development Environmental Impact Statement (EIS) will specify the mitigation measures that will be required on *federal lands* to reduce or eliminate adverse impacts. The State of Wyoming, through the Wyoming Oil and Gas Conservation Commission (WOGCC), will administer the appropriate mitigation measures on private and State lands.

For the most part, Moxa Operators have company Spill Prevention and Control Countermeasure (SPCC) plans; have participated in the on-going mitigation plan for wildlife and livestock forage loss; and have been involved in the development of a field transportation and road maintenance agreement plan. Continued authorization of APDs and ROWs will depend on these plans being finalized. In addition, concurrence by the U.S. Fish and Wildlife Service (FWS) in the threatened and endangered species impact analysis conclusions would be necessary. Site-specific erosion control, restoration, and revegetation plans (ERRPs) would be developed by each operator and submitted with the APD and ROW applications.

Approval of individual project components (i.e., wells, roads, pipelines, and ancillary facilities) for the Moxa analysis area would be contingent upon a site-specific cultural resource file search and Class III cultural clearance, paleontological clearance, special status species surveys, site-specific environmental assessment (EA), and decision records for each well, road, pipeline, or other facility unless otherwise provided by the AO.

The AO, in consultation with other agency personnel (e.g., the Wyoming Game and Fish Department [WGFD], FWS, Bureau of Reclamation [BOR], etc.), would approve the initiation of well location construction, drilling, completion, and production facility installation on a case-by-case basis when sensitive resource constraints (e.g., wildlife, special status species, etc.) are involved. This action would allow project activities to proceed in areas and/or during periods of restriction if deemed appropriate by the AO (e.g., during mild winters, at abandoned raptor nest sites, etc.). Exceptions would be granted only in cases where adherence to lease and/or unit area stipulations is not necessary. The Moxa Operators would be encouraged to submit APDs and ROW applications for development activities on crucial winter ranges such that there is sufficient time to complete all activities prior to critical winter periods.

5.2 MONITORING

Monitoring is a requirement provided for in the Code of Federal Regulations (40 CFR 1501.2(c) and 1503.3). This regulation, in its requirements for the Record of Decision, states that "... [a] monitoring and enforcement program shall be adopted and summarized where applicable for any mitigation" (1505.2[c]). Specific monitoring that would be needed has been identified following the environmental impact analysis and is listed in Chapter 2 (Section 2.2.4) and Chapter 4, Mitigation Summary for each resource discipline. A summary of monitoring expectations for each resource discipline that requires monitoring is provided as follows.

The Moxa Operators would identify individuals to serve as Environmental Compliance Coordinators. These persons would be responsible for ensuring that mitigation measures are applied and maintained and that monitoring activities are conducted as necessary throughout the life of the facility or field to ensure impacts are minimized.

5.2.1 Transportation

The Moxa Operators and the BLM would provide qualified representatives on-the-ground during construction to validate construction commensurate with the approved design. Road signs in the Moxa analysis area would be maintained and monitored by the Operators, who would conduct all maintenance and monitoring operations in a manner that would ensure that signs are in proper repair and placed in appropriate locations.

5.2.2 Geology/Minerals/Paleontology

In addition to the predisturbance survey conducted as deemed appropriate by the BLM, specific and unavoidable high-value sites would be monitored as necessary by a qualified paleontologist during construction. If significant paleontological materials are found during construction, construction activities that could adversely affect the find would cease or be redirected, and the AO would be notified immediately by the operator or the subcontractor(s) to ensure proper handling of the discovery by a qualified paleontologist.

5.2.3 Soils

The Moxa Operators would conduct regularly scheduled monitoring of erosion control structures within the Unit to ensure maintenance of the operating integrity of these structures. Monitoring procedures and schedules would be specified in the APD or ROW grant. Appropriate remedial action would be taken by the Operators to correct non-functioning structures.

Successful revegetation is defined as short-term attainment of native plant cover comparable to 50 percent of predisturbance cover within three years. The operator would be released from continued revegetation monitoring requirements when a site reaches 80 percent of predisturbance cover usually within five years.

Operators would be responsible for monitoring reclamation success and site stability using reclamation guidelines presented in Appendix B.

5.2.4 Water Resources

The Moxa Operators and the BLM would conduct regularly scheduled visual monitoring reconnaissance of surface waters to detect changes in water quality resulting from sedimentation. Periodic water samples would be collected, analyzed, and evaluated at a qualified laboratory to ensure that produced water and water disposal methods, as well as any onsite discharge, are in compliance with federal and State water quality standards. In addition, if waters are discharged to the surface, the quantity would be regularly monitored to ensure that releases do not exceed the abilities of existing drainage systems to convey discharge flows. Special care would be taken to reduce runoff from roads and well pads located close to the Hams Fork, Black Fork, or Green River. Appropriate remedial actions would be immediately taken to correct any out-of-compliance conditions.

5.2.5 Vegetation and Wetlands

The Moxa Operators and the BLM would monitor activities adjacent to wetlands and other waters of the U.S. to ensure that no unauthorized discharge of fill and/or excavation would disturb these areas. In cooperation with the BLM, the Operators would be responsible for monitoring revegetation success and noxious weed invasion and establishment using criteria specified in Appendix B and in Section 5.2.3, Soils. The reclamation program shall include written documentation to be furnished to the BLM regarding the effectiveness and success of reclamation mitigation.

5.2.6 Wildlife

The Moxa Operators, the BLM, and the WGFD would identify additional opportunities to mitigate for habitat loss and continue the implementation of the on-going mitigation plan. Moxa Operators, in cooperation with the BLM and WGFD, would monitor raptor nesting and sage grouse lek use both on and adjacent to the Moxa development to ensure that these sensitive resources are protected throughout the life of the project. In addition, breeding bird surveys may be required periodically by the BLM. The Moxa Operators and the BLM would also monitor project activity in big game crucial winter ranges during critical periods to ensure that no unauthorized use occurs and that authorized activities in these areas are conducted in the most efficient manner possible to limit potential adverse impacts.

Any big game, raptor, and game bird mortalities noted in the analysis area by the Operators must be reported to the BLM, FWS, and/or the WGFD as soon as practical.

5.2.7 Special Status Species

If found at or proximal to a proposed project location (e.g., well site, pipeline or road ROW, or ancillary facility site) during site-specific surveys, flagged population boundaries of special status plants would be monitored by a BLM-approved botanist during earth-disturbing activities. Monitoring would ensure that provisions outlined by the BLM and FWS for protection of the special status plant species are adhered to throughout the construction of the facility. Periodic site-visits should occur by the BLM or an approved botanist during operation of the facility to ensure that no unforseen impacts have occurred.

Any mortality of special status wildlife species in the Moxa analysis area noted by the Operators must be reported to the BLM and/or the WGFD as soon as practical.

Water consumption monitoring would occur per the "Windy Gap Process."

5.2.8 Cultural Resources

In addition to Class III inventories, construction activities may also be occasionally field-checked by the BLM or by a qualified, BLM-permitted archeologist. If historic or prehistoric materials were discovered during construction, all activities at the site would cease immediately and the appropriate BLM personnel would be notified by the operator or the subcontractor(s) to ensure proper handling of the discovery by a qualified archeologist.

5.2.9 Health and Safety

Hazardous materials used, produced, transported, stored, and disposed of as a component of this project would be done in accordance with all federal and state rules and regulations. Any hazardous material spills would be handled as specified in SPCC plans and in Appendix C. The Moxa Operators would be responsible for reporting spills and implementing applicable procedures, monitoring, and reporting requirements.

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CHAPTER 6

CONSULTATION AND COORDINATION

CHAPTER 6

CONSULTATION AND COORDINATION

6.0 CONSULTATION AND COORDINATION

An environmental impact statement (EIS) must be prepared when a federal government agency considers approving an action within its jurisdiction that may impact the human environment. An EIS aids federal officials in making decisions by presenting information on the physical, biological, and social environment of a proposed project and its alternatives. As previously mentioned in Chapter 2, the first step in preparing an EIS is to determine the scope of the project, the range of action alternatives, and the impacts to be included in the document.

The Council on Environmental Quality (CEQ) regulations (40 CFR, Parts 1500-1508) require an early scoping process to determine the issues related to the proposed action and alternatives that the EIS should address. The purpose of the scoping process is to identify important issues, concerns, and potential impacts that require analysis in the EIS and to eliminate insignificant issues and alternatives from detailed analysis.

The Expanded Moxa Arch Natural Gas Development project (Moxa) EIS was prepared by a third party contractor working under the direction of and in cooperation with the lead agency for the project, which is the Bureau of Land Management (BLM) Kemmerer Resource Area (KRA), and Rock Springs District Office, Rock Springs, Wyoming.

6.1 PUBLIC PARTICIPATION

A Scoping Notice was prepared and submitted to the public by the BLM on March 11, 1994, requesting input into the proposed Expanded Moxa Arch Area Natural Gas Development project. Scoping documents were sent out to the public listed on the BLM mailing list, as well as organizations, groups, and individuals requesting a copy of the scoping document.

There were 22 written responses received during the scoping period in response to this project. These written responses consisted of seven letters in favor of the drilling proposal and fifteen letters that did not state a position in regard to the project but provided suggested mitigation if the project were implemented. There were no letters that specifically stated the project should not be implemented. The issues and concerns identified by the public during the scoping period are summarized in Chapter 1.

During preparation of the EIS, the BLM and the consultant interdisciplinary team (IDT) have communicated with, and received or solicited input from various federal, State, county, and local agencies, elected representatives, environmental and citizens groups, industries, and individuals potentially concerned with issues regarding the proposed drilling action. The contacts made are summarized in the following sections.

The following organizations/individuals either provided comment or were provided the opportunity to comment during the scoping period.

6.1.1 Government Offices

Ashley National Forest, Manila, UT
Ashley National Forest, Vernal, UT
Bureau of Mines, Washington D.C.
Environmental Protection Agency, Region 8
Lincoln County Planning Office, Kemmerer, WY
Lincoln County Commissioners, Kemmerer, WY
LaBarge Branch Library, Labarge, WY
Lincoln County Library, Kemmerer, WY
Lincoln County Office of Planning and Development, Kemmerer, WY
Mayor of Big Piney, Big Piney, WY
Mayor of Diamondville, Diamondville, WY
Mayor of Granger, Granger, WY
Mayor of Green River, Green River, WY
Mayor of Kemmerer, Kemmerer, WY
Mayor of Labarge, Labarge, WY
Mayor of Marbleton, Marbleton, WY
Mayor of Opal, Opal, WY
Mayor of Pinedale, Pinedale, WY
Mayor of Rock Springs, Rock Springs, WY
National Park Service, Division of Environmental Compliance, Washington D.C.
Shoshone-Arapaho Tribe
State Representative Bud Nelson
State Representative Chris Boswell
State Representative Elwin Mcgrew
State Representative Louie Tomassi
State Representative Louise Ryckman

State Representative Wayne Morrow
State Senator Boyd L. Eddins
State Senator Carl Maldonado
State Senator Frank Prevedel
State Senator Gregory A. Phillips
State Senator Mark Harris
Sublette County Planning Office
Sweetwater County Commissioners
Sweetwater County Engineer
Sweetwater County Land Use Department
Sweetwater County Library
Sweetwater County Planning Department
Uinta County Planning Office
Uinta County Commissioners
Uinta County Development Company
Uinta County Library
U.S. Army Corps of Engineers, Cheyenne, WY
U.S. Army Corps of Engineers, Omaha, NE
U.S. Department of Energy, Washington D.C.
U.S. Fish & Wildlife Service, Denver, CO
U.S. Fish & Wildlife Service, Cheyenne, WY
U.S. Geological Survey
U.S. Representative Craig Thomas
U.S. Senator Alan K. Simpson
U.S. Senator Malcolm Wallop
USDA-Soil Conservation Service
USDI-Bureau of Land Management, Cheyenne, WY
USDI-Bureau of Land Management, Green River Resource Area, Rock Springs, WY
USDI-Bureau of Land Management, Pinedale, WY
USDI-Bureau of Land Management, Rawlins, WY
USDI-Bureau of Land Management, Kemmerer, WY
USDI-Bureau of Mines, Washington D.C.
USDI-Bureau of Mines, Denver, CO
USDI-Bureau of Reclamation, Denver CO
USDI-Bureau of Reclamation, Salt Lake City, UT
USDI-Bureau of Reclamation, Provo, UT
USDI-Bureau of Reclamation, Washington D.C.
USDI-Minerals Management Service
USDI-Office of Surface Mining
Wyoming Department of Transportation
Wyoming Department of Environmental Quality, Lander, WY
Wyoming Department of Environmental Quality, Cheyenne, WY
Wyoming Game & Fish Department, Kemmerer, WY
Wyoming Game and Fish Department, Green River, WY
Wyoming Game and Fish Department, Cheyenne, WY
Wyoming Game and Fish Department, Pinedale, WY
Wyoming Oil and Gas Conservation Commission
Wyoming State Historical Preservation Office
Wyoming State Planning Coordinator's Office

6.1.2 Organizations

Animal Protection Institute of America
Defenders of Wildlife
Environmental Defense Fund
Friends of Wild Wyoming Deserts
Greater Yellowstone Coalition
Humane Society of the U.S.
Medicine Butte Wildlife Association
Medicine Wheel Alliance
National Wildlife Federation, Boulder, CO
National Wildlife Federation, Washington D.C.
Natural Resources Defense Council, Washington D.C.
Northwestern University
OCTA-Wyoming Chapter
Oregon-California Trails Association
Oregon-California Trails Association
Powder River Basin Resource Council
Rock Springs Grazing Association
Rocky Mountain Oil & Gas Association
Sierra Club, Washington D.C.
Sierra Club, Sheridan, WY
Sierra Club, Dubois, WY
Society for Range Management
Southwest Wyoming Industrial Association
Sweetwater Wildlife Association, Rock Springs, WY
The Nature Conservancy, Laramie, WY
The Wilderness Society, Boise, ID
Trout Unlimited, Jackson, WY
Trout Unlimited-FG Chapter, Green River, WY
Utah Power & Light Company
Washington Energy
Western Organization of Resource Councils
Western Wyoming Range Ltd Partnership
Wind River Multiple Use Advocates
Wyoming Association of Professional Archaeologists
Wyoming Advocates for Animals
Wyoming Heritage Society
Wyoming Mining Association
Wyoming Outdoor Council
Wyoming Public Lands Council
Wyoming Sportsman's Association (Access)
Wyoming Wildlife Federation, Cheyenne, WY
Wyoming Wildlife Federation, Rock Springs, WY

6.1.3 Industry

Amoco Production Co.
Banko Petroleum Management
Bannon Energy Inc.
Barlow & Haun Inc.
Bjork, Seavy, Lindley, & Danielson
Centennial Engineering
Dalen Resources Oil & Gas Company, Vernal, UT
Dalen Resources Oil & Gas Company, Dallas, TX
Debernardi Brothers
Exxon Company U.S.A.
E&P Environment, Salt Lake City, UT
E&P Environment, Houston, TX
El Paso Natural Gas Co.
Enron Oil & Gas Co., Big Piney, WY
Enron Oil & Gas Co., Denver, CO
Enron Oil & Gas Co., Houston, TX
FMC Wyoming Corporation
General Chemical Co.
Independent Petroleum Association of Mountain States
J.A. Rohn Consulting
Land Management Services
Mariah Associates Inc.
Marathon Oil Co.
Mountain Gas Resources Inc.
Northwest Pipeline Corporation
Otto Peternal & Company
Pacific Corp, Casper, WY
Pacificorp, Portland, OR
Painter & Company Inc.
Petroleum Association of Wyoming
Petry-Storey & Associates
PIC Technologies Inc.
Presidio Energy Inc.
Questar Pipeline Co.
Rhone-Poulenc of Wyoming Co.
SWEDA
Tenneco Minerals, Houston, TX
Tenneco Minerals, Green River, WY
Texaco Exploration & Production Inc., Rock Springs, WY
Texaco Inc, Denver, CO
TG Soda Ash Inc.
Union Pacific Resources Co., Rock Springs, WY
Union Pacific Resources Co., Fort Worth, TX
Wexpro Company
Williams Field Services
Woodward/Clyde Consultants

6.1.4 Landowners/Permittees/Individuals

Marion Aimone Estate
Martin Aimone & Son
Kathy Armstrong
Kathryn Bates
Big Sandy & Green River Livestock
Steve Black
William Black
Paul D. Blasi
Rodney & Nola Bluemel
Arline Brethouwer
Howard and Marian Brinton
J.R. Broadbent
Beverly Calhoun
Robert and John Child
Nancy Dewolf
Barbara Dill
DJR Land & Livestock
Linford Ellett
Evelyn N. Cope Revocable Trust
Frank Fear
R. Gunter Family Partnership
Flying W Land & Livestock Co.
A. M. Hafey
Julienne Harrower
Harrower Ranches
Richard Ison
Cecil Jones
Julian Land & Livestock Corporation
Arnold Larson
Larson Hereford Ranch
Larson Livestock Inc.
Carl Larson
Jack Lee
Elton and Patsy Lester
Vernal Long
Logan Macmillan
James H. Magagna
Frank Mau
Kim and Laurie McKee
Barry Mcmullan
Kirk Miller
Brent & Debbie Murphy; JD Thompson
Ida Peternal
Lauriel Peters
Victor Powers
Angelina Pryich
Redden Land & Livestock Co.

Karen A. Rennells (OCTA)
Gary Rickert
Riverside Livestock
L.W. Roberts
Gary P. Rollins
John and Kathleen Rosas
Alice Shaffer
Sims Livestock
Raul Seone
Robert D. Taylor
William J. Thoman
Thomas Thornock
William H. Tripp
Dave Vlcek
Glen and Faye Wadsworth
Alan K. Walker
Rulon F. Wells
Lucille Wendt
John Williams
Edward Wolfe
Paula Wonnacott
Walter Yose

6.1.5 Newspapers/Radio Stations/Television

Casper Star Tribune (Casper, WY)
Casper Star-Tribune (Green River, WY)
Casper Star-Tribune (Rock Springs, WY)
Green River Star (Green River, WY)
Jackson Hole Daily (Jackson, WY)
Jackson Hole News (Jackson, WY)
Jackson Hole Guide (Jackson, WY)
KC, WY-TV (Casper, WY)
Kemmerer Gazette (Kemmerer, WY)
KEVA (Evanston, WY)
KFNB-TV (Casper, WY
KGWC-TV (Casper, WY)
KMER (Kemmerer, WY)
KMTN/KSGT (Jackson, WY)
KQSW/KRKK (Rock Springs, WY)
KRSV-AFTON (Afton, WY)
KSIT (Rock Springs, WY)
KTWO-TV and KTWO Radio (Casper, WY)
KUGR (Green River, WY)
KYCS (Rock Springs, WY)
Pinedale Roundup (Pinedale, WY)
Rocket Miner (Rock Springs, WY)
Sweetwater Television (Rock Springs, WY)
Uinta County Herald (Evanston, WY)
Wyoming State Journal (Lander, WY)

6.2 LIST OF PREPARERS

The following tables identify the core BLM IDT (Table 6-1) and the consultant IDT (Table 6-2) that were principally involved with preparing this EIS.

Table 6-1. List of BLM Interdisciplinary Reviewers.

Name	Responsibility
BUREAU OF LAND MANAGEMENT	
Rock Springs District	
Bill McMahan	Project Coordinator
Wayne Sutherland	Geology
Barb Amidon	Special Status Plants
Don Schramm	Engineer
John Henderson	Wetlands/Riparian Areas
Elaine Raper	Wildlife
Dennis Doncaster	Water Quality
John MacDonald	Soils/Reclamation
Alan White	Hazardous Materials
Kemmerer Resource Area	
Carl Bezanson	Range Resources
Wally Mierzejewski	Environmental Compliance, Reclamation/Monitoring
John Pecor	Health and Safety
Gary McNaughton	Paleontology/Geology
Dori Heilig	Recreation and Visual Resources
Vernon Phinney	Wildlife/Fisheries, Special Status Animals
Mark Hatchel	Realty/Lands
Vickie Herrin	Mitigation Plan, Wildlife/Livestock Forage Loss
Wyoming State Office	
Vickie Daniels	Mined Minerals
Darlene Horsey	Environmental Coordinator
Laurie Bryant	Paleontologist
Mark Gorges	Fisheries
Jeff Carroll	Botanist
Tim Novak	Archaeologist
Jode Carino	Historic Trails
Lynn Harrell	Cultural Resources
Scott Archer	Air Quality

Table 6-2. List of Consultant Interdisciplinary Team EIS Preparers.

Name	Affiliation	Responsibility
Principal Interdisciplinary Team		
Gary Holsan	Gary Holsan Environmental Planning	Interdisciplinary Team Leader, Project Manager, Health and Safety, Range Resources
Oliver John Grah	ECOTONE Environmental Consulting, Inc.	Assistant Project Manager, Soils, Water Resources, Vegetation and Wetlands, Special Status Plants, Reclamation, Climate, Document Production
Larry Hayden-Wing	Hayden-Wing Associates	Wildlife/Fisheries, Special Status Animals and Fish
George Blankenship	Planning Information Corporation	Socioeconomics and Transportation
Craig Johnson	ECOTONE Environmental Consulting, Inc.	Visual Resources and Recreation
Clifford Cole	TRC Environmental Corporation	Air Quality
Jana Pastor	Western Wyoming College	Cultural Resources
Gustav Winterfeld	Erathem-Vanir Geological Consultants	Geology/Paleontology, Mineral Resources
Technical Support Team		
Juli Elayne Crane	ECOTONE Environmental Consulting, Inc.	Soils, Climate, Water Resources, Vegetation and Wetlands, Special Status Plants, Document Editing
Karen Matsumoto	ECOTONE Environmental Consulting, Inc.	Document Editing and Production
Ron Dean	Gary Holsan Environmental Planning	Range Resources
Jay Meyer	Planning Information Corporation	Socioeconomics and Transportation
Angel Crane	ECOTONE Environmental Consulting, Inc.	Document Editing
Shelley Williams	ECOTONE Environmental Consulting, Inc.	Document Editing and Production

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GLOSSARY

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abandon: To cease producing oil or gas from a well when it becomes unprofitable. A wildcat (exploration) well may be abandoned after it has been proven nonproductive. Usually, some of the casing is removed and salvaged, and one or more cement plugs placed in the borehole to prevent migration of fluids between formations.

act: The National Environmental Policy Act, as amended (42 U.S.C. 4321, et seq.) which is also referred to as "NEPA" (40 CFR 1508.2).

action alternative: Those alternatives which propose some degree of construction, development, improvement or rehabilitation. In this EIS, it includes all alternatives except Alternative C, the "No Action" alternative.

acre-foot: A volume of water that covers an area of one acre to a depth of one foot (43,560 cubic feet or 325,851 gallons).

acquired minerals: Mineral rights that were patented into nonfederal ownership and were later re-acquired by the United States.

ad valorem: Imposed at a rate percent of the value as stated in an invoice.

affected environment: The biological, physical, and socioeconomic environment that will or may be changed by actions proposed and the relationship of people to that environment.

agatized: Formed or shaped through volcanic processes; rocks [agates] formed in such a manner are found in vugs in volcanic rocks and in cavities of some other rocks.

airshed: A geographic area that shares the same air because of topography, meteorology, and climate.

allotment: An area of land where one or more permittees graze their livestock. Generally consists of public land but may include parcels of private or State lands. The number of livestock and season of use are stipulated for each allotment. An allotment may consist of several pastures or be only one pasture.

Allotment Management Plan: The document that contains the action program needed to manage the range resource for livestock grazing with consideration given to soil, watershed, wildlife, recreation, timber and other resources on lands within a range allotment or on a wild horse or burro territory. Allotment management plans, territory plans, and where appropriate, coordinated resource management plans identify prescriptions and practices for the management or grazing and browsing lands for livestock and wild horses and burros.

alkaline soil: A soil with a pH of 8.5 or greater or at least 15 percent exchangeable sodium or both. Plant growth is typically reduced in such soils.

alluvium: A general term for all detrital deposits resulting from the operations of modern rivers, thus including the sediment laid down in riverbeds, floodplains, lakes, fans at the foot of mountain slopes, and estuaries.

alternative: A combination of management prescriptions applied in specific amounts and locations to achieve a desired management emphasis or expressed in goals and objectives. One of several policies, plans, or projects proposed for decision making.

alternative, No Action: An alternative that maintains established trends or management direction.

animal unit month (AUM): The amount of forage necessary for the sustenance of a 1,000-lb dry cow in maintenance or gestation or five sheep for 1 month.

annulus: The space around a pipe in a wellbore, the outer wall of which may be the wall of either the borehole or the casing.

Application for Permit to Drill, Deepen or Plug Back (APD): The Department of Interior application permit form to authorize oil and gas drilling activities on federal land.

aquatic bed: Wetland and deepwater habitats dominated by plants that primarily grow on or below the surface of the water. For comparison, see Emergent Vegetation.

aquifer: A water-bearing bed or layer of permeable rock, sand, or gravel capable of yielding water; or the part of a water-drive reservoir that contains the aquifer.

archaeological resources: All prehistoric and historic physical evidence of past human activity which can be used to reconstruct lifeways and cultural history of past peoples. These resources include sites, artifacts, environmental data, and all other relevant information and the contexts in which they occur.

artifact: Any object made, modified, or used by humans, usually movable. Objects which are recorded as prehistoric or historic artifacts have sociocultural or scientific values and meet the general criterion of being more than 50 years old.

at depth: A reference made to some depth relatively deep in the earth's surface.

badland: Steep or very steep, commonly non-stony barren land dissected by many intermittent drainage channels. Badland is most common in semi-arid and arid regions where streams are entrenched in soft geologic material. Runoff potential is very high, and geologic erosion is active in such areas.

base flow: Sustained runoff composed largely of groundwater discharge.

big game: Those species of large mammals normally managed as a sport hunting resource.

BLM: See Bureau of Land Management.

blowout: An uncontrolled expulsion of gas, oil, or other fluids from a drilling well. A blowout or "gusher," occurs when formation pressure exceeds the pressure applied to it by the column of drilling fluid and when blowout prevention equipment is absent or fails.

borehole: A circular hole made by boring; especially a deep hole of small diameter, such as an oil well or a water well.

Bureau of Land Management (BLM): The Department of Interior agency responsible for managing most Federal Government subsurface minerals. It has surface management responsibility for Federal lands designated under the Federal Land Policy and Management Act of 1976.

calcareous: Containing calcium carbonate. When applied to a rock name, it implies that as much as 50% of the rock is calcium carbonate.

candidate species: Species that are presently being considered to be added to the list as either threatened or endangered. Results depend on further studies.

carrying capacity: The ability of an area of land to sustain a species [generally livestock] over time without permanently degrading the land resources.

casing: Steel pipe placed in an oil or gas well to prevent the hole from collapsing.

cation exchange capacity: The capacity for the interchange of cations in solution with another cation on the surface of an active material.

CEQ: See Council of Environmental Quality.

CFR: Code of Federal Regulations.

cfs: cubic feet per second; a measure of streamflow volume. One cubic foot is 7.48 gallons. A flow of 1 cfs would produce 448.8 gallons per minute.

channery soil: A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches long. A single piece is called a fragment.

chert: A hard, dense microcrystalline or cryptocrystalline sedimentary rock, composed chiefly of interlocking crystals of quartz and possibly some amorphous silica (opal). Occurs principally in limestone and dolomite and may be an organic or an inorganic precipitate or replacement product. Also synonymous with *flint*.

Class(es): As they refer to streams, airsheds, archeology

Airshed Classes: Atmospheric stability class is the measure of the atmospheric turbulence, and affects the potential for pollutant dispersion. The stability is divided into six categories, designated "A" through "F." The greatest pollutant dispersion occurs during class "A," and the least occurs during class "F". The table below shows the wind direction distribution (direction from which the wind blows).

Archeological Classes: Classes used to categorize levels of study/analysis of an archeological site. Classes utilize roman numerals; i.e., Class I, II, II.

Wind Speed and Stability Class Distributions.

Wind Speed (knots)	Frequency (percent)	Stability Class	Frequency (percent)
0-3	11.7	A	0.81
4-6	23.5	B	5.18
7-10	23.5	C	11.19
11-16	23.0	D	50.80
17-21	9.7	E	17.54
Greater than 21	3.2	F	14.48

Source: SCRAM 1994.

Visual Management Classes: Management classes for visuals describe different degrees of modification allowed to the basic elements of the landscape. Class designations are derived from an overlay technique that combines the maps of Scenic Quality, Sensitivity Levels and Distance Zones. Scenic quality uses subcategories to narrow a class into a further subdivided A, B, or C class with "A" being the highest. Sensitivity Level is rated on a High-Medium-Low scale based on user attitude and use volume. Distance zones characterize viewsheds and distances to them by the using the terms foreground/middleground, background and seldom seen to identify the predominance and importance of such areas visually/aesthetically. The overlays of each of these major mapped categories are used to identify areas with similar combinations of factors. These areas are assigned to one of five management classes according to predetermined criteria. Changes allowable under each class designation are discussed below.

Class I - Natural ecological changes and very limited management activity are allowed. Any contrast created within the characteristic landscape must not attract attention. This classification is applied to wilderness areas, wild and scenic rivers, and other similar situations.

Class II - Changes in any of the basic elements (form line, color, texture) caused by a management activity should not be evident in the characteristic landscape. Contrasts are seen, but must not attract attention.

Class III - Contrasts to the basic elements caused by a management activity are evident, but should remain subordinate to the existing landscape.

Class IV - Any contrast attracts attention and is a dominant feature of the landscape in terms of scale, but it should repeat the form, line, color and texture of the characteristic landscape.

Class V - The classification is applied to areas where the natural character of the landscape has been disturbed to a point where rehabilitation is needed to bring it up to one of the four other classifications. The classification also applies to areas where unacceptable cultural modification has lowered scenic quality; it is often used as an interim classification until objectives of another class can be reached.

WDEQ Stream/Fisheries Classes:

Class 1 - surface waters in which no further water quality degradation by point source discharges other than from dams will be allowed. Nonpoint sources of pollution shall be controlled with appropriate best management practices. Considerations employed during the designation of these waters include water quality, aesthetic, scenic, recreational, ecological, agricultural, geological, the presence of significant quantities of developable water, and other values of present and future benefit to people.

Class 2 - surface waters other than Class 1 determined to be presently supporting game fish or have the hydrologic and natural water quality potential to support game fish, or include nursery areas or food sources for game fish.

Class 3 - surface waters other than Class 1 which are determined to be presently supporting non-game fish only, or have the hydrologic and natural water quality potential to support non-game fish only, or include nursery areas or food sources for non-game fish only.

Class 4 - surface waters other than Class 1 which are determined to not have the hydrologic or natural water quality potential to support fish.

WGFD Stream/Fisheries Classes:

Class 1 - premium through waters; fisheries of national importance.

Class 2 - very good trout waters; fisheries of state-wide importance.

Class 3 - important trout waters; fisheries of regional importance.

Class 4 - low-production trout waters; fisheries frequently of local importance but generally incapable of substantial fishing pressure.

Class 5 - very low-production waters, often incapable of sustaining a trout fishery.

closed mud system: A drill mud system that reuses or reclaims all the drilling fluid used. Oil-base mud systems are often closed mud systems.

colluvium: A general term applied to loose and incoherent deposits, usually at the foot of a slope or cliff and brought there chiefly by gravity. Talus and cliff debris are included in such deposits.

community: An aggregate of organisms that form a distinct ecological unit. Such a unity may be defined in terms of plants, animals, or both.

completion: The activities and methods to prepare a well for production. Includes installation of equipment for production from an oil or gas well.

cooperating agency: Any Federal agency other than a lead agency which has jurisdiction by law or special expertise with respect to any environmental impacts involved in a proposal (or a reasonable alternative) for legislation or other major Federal action significantly affecting the quality of the human environment. The selection and responsibilities of a cooperating agency are described in (1501.6). A State or local agency of similar qualifications or, when the effects are on a reservation, an Indian Tribe, may by agreement with the lead agency become a cooperating agency.

Council: The Council on Environmental Quality established by Title II of the National Environmental Policy Act of 1969.

Council on Environmental Quality: An advisory council to the President established by the National Environmental Policy Act of 1969. It reviews Federal programs for their effect on the environment, conducts environmental studies, and advises the President on environmental matters.

cover: The material covering the soil and providing protection from, or resistance to, the impact of raindrops and the energy of overland flow, and expressed in percent of the area covered. Composed of vegetation, litter, small rock, and large rocks. These materials may be lying on or within 20 feet of the ground surface.

cover type: A term describing the general characteristic or attribute of an area, often based on vegetative characteristics.

cratonic: of or referring to part of the earth's crust that has attained stability and has been little deformed for a long time; restricted to continents.

critical wildlife habitat: That portion of wildlife habitat that is essential to the survival and perpetuation of threatened and endangered species as designated by the U.S. Fish and Wildlife Service.

crucial range: Any particular seasonal range or habitat component that has been documented as the determining factor in a population's ability to maintain itself at a certain level over the long-term.

cubic feet per second (cfs): The rate of discharge representing a volume of 1 cubic foot of water passing a given point during 1 second.

cultural resources: The physical remains of human activity (artifacts, ruins, burial mounds, petroglyphs, etc.) and the conceptual content or context (as a setting for legendary, historic, or prehistoric events, such as a sacred area of native peoples, etc.) of an area of prehistoric or historic occupation.

cumulative action: Actions, which when viewed with other proposed actions have cumulatively significant impacts and should therefore be discussed in the same impact statement. (40 CFR 1508.25).

cumulative impact: The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taken place over a period of time. (40 CFR 1508.7).

decibel: A unit of measurement of noise intensity. The measurements is based on the energy of the sound waves and units are logarithmic. Changes of 5 decibels or more are normally discernable to the human ear.

decision document: A record of decision, decision memo, or decision notice.

deepen: To increase the depth of a well. Deepening is generally a workover operation to produce from a deeper formation or to control excessive gas found in the upper levels of a reservoir.

demographics: The statistical characteristics of a human population.

detrivores: Refers to organisms which feed on fragmented particulate organic matter.

development well: A well drilled in proven territory (usually within one mile of an existing well).

directional drilling: The intentional deviation of a wellbore from vertical to reach subsurface areas off to one side from the drilling site.

discharge: The volume of water and sediment passing a given point within a given period of time.

displacement: As applied to wildlife, forced shifts in the patterns of wildlife use, either in location or timing of use.

disposal well: A well into which produced water from other wells is injected into an underground formation for disposal.

dissolved solids: The total amount of dissolved material, organic and inorganic, contained in water or wastes.

dolomitic: Of or pertaining to a common rock-forming mineral $CAMG(CO_3)_2$.

drill pad: Relatively flat work area that contains equipment and facilities used for well drilling and well completion.

drill pipe: The heavy seamless tubing used to rotate the drill bit and circulate the drilling fluid. The standard drill pipe section is 30 feet long (a joint).

drill rig: The mast, draw works, and attendant surface equipment of a drilling workover unit.

dry hole: Any well incapable of producing oil or gas in commercial quantities. A dry hole may produce water, gas or even oil, but not enough to justify production.

dry deposition: Particulates that settle in dry form (often from dust that condenses on gases in atmosphere, e.g., from smokestacks); the laying-down of rock-forming material by any natural agent except water.

ecosystem: Collectively, all populations in a community, plus the associated environmental factors.

ecotone: A transition area, for example the zone between two distinct plant communities like aspen and spruce/fir.

effects: These include: a) **Direct effects**, which are caused by the action and occur at the same time and place; b) **Indirect effects**, which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems. Effects and impacts as used in these regulations are synonymous. Effects includes ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, historic, cultural, economic, social, or health, whether direct, indirect, or cumulative.

Effects may also include those resulting from actions which may have both beneficial and detrimental effects, even if on balance the agency believes that the effect will be beneficial (40 CFR 1508.8).

effluent: A discharge of pollutants, partially or completely treated or in its natural state into the environment. Generally used in regard to discharges into waters.

egress: Opposite of ingress (see ingress). Act/ability of leaving/exiting; permission granted for exit (as in permission to exit an area gained entrance through permit, etc.).

emergent vegetation: Erect, rooted, herbaceous plants that project out of the water, or "emerge." For comparison, see aquatic bed.

endangered animal species: Any animal species in danger of extinction throughout all or a significant portion of its range. This definition excludes species of insects that the Secretary of the Interior determines to be pests and whose protection under the Endangered Species Act of 1973 would present an overwhelming and overriding risk to man.

endangered plant species: Species of plants in danger of extinction throughout all or a significant portion of their ranges. Existence may be endangered because of the destruction, drastic change, or severe curtailment of habitat, or because of over exploitation, disease, predation, or even unknown reasons. Plant taxa from very limited areas (e.g., the type localities only), or from restricted fragile habitats usually are considered endangered.

endemic: Restricted to a geographic region, topographic unit, or particular soil condition.

environmental analysis (EA): An investigation of a proposed action and alternatives to that action and their direct, indirect, and cumulative environmental impacts; the process which provides the necessary information for reaching an informed decision and the information needed for determining whether a proposed action may have significant environmental effects and determining the type environmental documents required.

environmental assessment: A concise public document (required by NEPA) that analyzes all actions and their predictable short- and long-term environmental effects, including biological, physical, economic, and social factors and their physical, economic, and social factors and their interactions (USDA-FS 1979). This document is less extensive than an environmental impact statement.

environmentally conservative: Assumes an environmental outcome usually greater in impacts than the real outcome of an action; a method used or conclusion reached where the assessed impact is of a greater magnitude than that expected to occur as a result of the implemented action.

environmental impact statement (EIS): A detailed written statement as required by Sec. 102(2)(C) of the National Environmental Policy Act.

eolian: Pertaining to the wind; especially said of sedimentary structures such a wind-formed ripple marks, or of erosion and deposition accomplished by the wind.

ephemeral stream: A stream that flows only in direct response to precipitation in the immediate watershed or in response to the melting of a cover of snow and ice and which has a channel bottom that is always above the local water table.

erosion: The removal, detachment, and entrainment of earth materials by weathering, dissolution, abrasion, and corrosion, later to be transported by moving water, wind, gravity, or glaciers.

evaporite: One of the sediments which are deposited from aqueous solution as a result of extensive or total evaporation. Examples include anhydrite, rock salt, and various nitrates and borates.

exchangeable sodium percent (ESP): The percentage of the soil cation exchange capacity occupied by sodium ions.

exploration well: A well drilled in an area where there is no oil or gas production. Same as a "wildcat" well (see wildcat well).

extirpated: To remove/destroy totally; to pull up by the roots.

extant: Existing or living at the present time; *cf.* extinct.

extrusive: Said of igneous rock that has been erupted onto the surface of the earth. Includes rocks of lava flows and pyroclastic material.

fauna: animal life in general, especially the indigenous animals of a certain region, environment, or period.

federal lands: All lands and interests in lands owned by the U.S. that are subject to the mineral leasing laws, including mineral resources or mineral estates reserved to the U.S. in the conveyance of a surface or non-mineral estate.

FEIS: Final Environmental Impact Statement (see environmental impact statement).

fledge: *Of a bird*: To acquire the feathers necessary for flight; capable of flying.

flooding: The temporary covering of soil with water from overflowing streams, runoff from adjacent slopes, and tides. Water standing for short periods after rainfall or commonly covering marshes is not considered flooding.

floodplain: As defined by Executive Order 11988, as amended, lowland and relatively flat areas adjoining inland and coastal waters including flood prone areas of offshore islands, including at a minimum, that area subject to a one percent or greater chance of flooding in any given year.

flora: plant life in general, especially plants of a certain region, environment or period.

forage: Vegetation of all forms available for animal consumption.

forb: A broad-leafed flowering herb other than grass.

fracturing (fracing): A method of stimulating well production by increasing the permeability of the producing formation. Under extremely high hydraulic pressure, the fracturing fluid (water, oil, dilute hydrochloric acid, or other fluid) is pumped into the formation which parts or fractures it. Proppants or propping agents such as sand or glass beads are pumped into the formation as part of the fracturing job. The proppants become wedged in the open fractures, leaving channels for oil to flow into the well after the hydraulic fracture pressure is released. this process is often called a "frac job." When high concentrations of acid are used, it may be called an "acid frac job."

functional value: A term that refers to the various functions performed by wetlands and the values people place on those functions. Functions are the chemical, physical, and biological processes or attributes of a wetland without regard to their importance to society. They include groundwater recharge and discharge, sediment trapping, nutrient/pollutant retention and removal, shoreline anchoring and dissipation of erosive forces, food chain support, wildlife and fish habitat, and heritage value (including active and passive recreation, uniqueness, etc.).

game species: Any species of wildlife or fish for which seasons and bag limits have been prescribed, and which are normally harvested by hunters, trappers, or fishermen under State or Federal Laws, codes, and regulations.

gastropod: Any mollusk belonging to the class Gastropoda, characterized by a distinct head with eyes and tentacles and in most, by a single calcareous shell. Range: Upper Cambrian to present.

graminoid: A plant that looks like a grass, including grasses and grass-like species such as bulrush, sedge, or spikerush.

gully: A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall.

habitat: A specific set of physical conditions that surround a single species, a group of species, or a large community. In wildlife management, the major components of habitat are considered to be food, water, cover, and living space.

habitat type: An aggregation of all land areas potentially capable of producing similar plant communities of climax.

halophyte: A plant adapted for growing in salty soil.

hardness: A means of describing the degree to which the calcium and magnesium dissolved in water combine with soap to form an insoluble curd. Water with 0-60 mg/L $CaC0_3$ is soft water, 61-120 mg/L is moderately hard, 121-180 mg/L is hard, and more than 180 mg/L is very hard water.

historic resources: All evidences of human activity that date from historic (recorded history) periods.

human environment: The factors that include, but are not limited to biological, physical, social, economic, cultural and aesthetic factors that interrelate to form the environment.

hydric soils: A soil that is saturated, flooded, or ponded with water long enough during the growing season (i.e., soil temperature of 41°F at 20 inches depth) to develop anaerobic soil conditions (i.e., reduced oxygen levels). These soils develop characteristics that are indicative of the wet and anaerobic conditions. Such characteristics may include an undecomposed organic surface layer (histic epipedon), surface horizons with low chromas (i.e., very dark brown to black), organic staining and streaking, grey-colored layers of horizons, iron concretions, and/or light grey- or rust-colored mottles or specks of highly contrasting color. These characteristics must generally occur within 50 percent of the root zone.

hydroperiod: Variability in moisture conditions over time in regard to soil moisture, inundation, and/or flooding. relates to water table level, depth of inundation and flooding, and soil moisture.

hydrophytic plants: Those species which either require or tolerate wet or saturated soils and are therefore indicative of these conditions. Vegetation is a good indicator of the physical conditions on a given site. Such conditions include soil moisture.

hydrostratigraphy: The relationship of subsurface geologic units to the occurrence of aquifers and groundwater.

impact: The results of an action on the environment; the impact may be primary (direct) or secondary (indirect); the term impact is synonymous with effect according to 40 CFR 1508.8.

indicator species: A species of animal or plant whose presence is a fairly certain indication of a particular set of environmental conditions. Indicator species serve to show the effects of development actions on the environment.

indicator wildlife species: Indicator wildlife species are defined in two general categories: 1) those that are hunted and utilize diverse habitat conditions, and 2) those that utilize restricted habitat niches, are resident species, have wide distributions over an area and/or are easily monitored.

infill: The process of drilling and completing more production wells in a specific area.

ingress: Right or ability to go in; permission granted for entrance or admittance (as in admittance by permit, to an area).

injection well: A well used to inject fluids into an underground formation to increase reservoir pressure.

insectivore: Any insect-eating plant or animal.

interbedded: Said of beds lying between or alternating with others of different character, especially said of rock material laid down in sequence between other beds, such as a contemporaneous lava flow "interbedded" with sediments.

interdisciplinary team (IDT): A group selected to work within the NEPA process in scoping, analysis, and document preparation. The purpose of the team is to integrate its collective knowledge of the physical, biological, economic, and social sciences and the environmental design arts into the environmental analysis process. Interaction among team members often provides insight that otherwise would not be apparent.

intermittent stream: A stream or reach of a stream that drains a watershed of at least one square mile; or a stream or reach of a stream that is below the local water table for at least some part of the year, and obtains its flow from both surface runoff and groundwater discharge.

interstitial: Said of a mineral deposit in which the mineral fills the pores of the host rock.

intertonguing: The disappearance of sedimentary bodies in laterally adjacent masses owing to splitting into may thin tongues each of which reaches an independent pinch-out termination; the intergradation of markedly different rocks through a vertical succession of thin interlocking or overlapping wedge-shaped layers.

intrusive: Of or pertaining to intrusion, both the process and the rock so formed. The process of emplacement of magma in pre-existing rock; magmatic activity. Also, the igneous rock mass so formed.

irreversible: A term that describes the loss of future options. Applies primarily to the effects of use of nonrenewable resources, such as minerals or cultural resources, or to those factors, such as soil productivity that are renewable only over long periods of time.

irretrievable: A term that applies to the loss of production, harvest, or use of natural resources. For example, some or all of the timber production from an area is lost irretrievably while an area is serving as a winter sports site. The production lost is irretrievable, but the action is not irreversible. If the use changes, it is possible to resume timber production.

jurisdictional wetlands: "Those wetlands which are within the extent of COE regulatory overview" (33 CFR 328.1 and 2). For an area to be identified as a jurisdictional wetland, the area must exhibit positive indicators of wetland hydrology, hydrophytic vegetation, and hydric soils. Those areas that do not meet the three parameters are uplands or non-jurisdictional wetlands. The Corps of Engineers Wetlands Delineation Manual (Environmental Laboratory 1987) describes technical criteria for determining hydrophytic vegetation, hydric soils, and wetland hydrology, and therefore the occurrence of jurisdictional wetlands.

lag: 1) lag gravel 2) The time between the formation of potential sediment by weathering and its removal and deposition 3) The delay between the arrival of a seismic signal at a detector and the response.

lag gravel: A residual accumulation of coarse rock fragments on a surface after the finer material has been blown away by winds.

lead agency: The agency or agencies preparing or having taken primary responsibility for preparing the environmental impact statement (40 CFR 1508.16).

lease: 1) A legal document that conveys to an operator the right to drill for oil and gas.

2) The tract of land on which a lease has been obtained, where producing wells and production equipment are located.

lek: 1) An assembly area for communal courtship display or 2) A communal prenuptial display, specifically those displays involving ritualized contest between competitors, often for the use of symbolic sites.

lithology: 1) The description of rocks, esp. in hand specimen and in outcrop, on the basis of such characteristics as color, mineralogic composition, and grain size or 2) The physical character of a rock.

loam: A rich, permeable soil composed of a mixture of clay, silt, sand and organic matter.

marginal properties: Fee and/or federal lease holdings with natural gas/oil reserves that are approaching depletion to the extent that any profit from continued production is doubtful. An oil/gas holding becomes a marginal property when the cost to drill, complete, and equip the well exceeds the ability to recover these costs during its lifetime.

marlstone: 1) an indurated rock of about the same composition as marl, e.e. an earthy or impure argillaceous limestone. It has a blocky subconchoidal fracture, and is less fissile than shale. A term originally applied to slightly magnesian calcareous mudstones or muddy limestones in the Green River Formation of the Uinta Basin, Utah, but later applied to associated rocks with a variety of lithologic characters. Abandonment of the term as used in the Uinta Basin has been recommended.

mineral rights: Reserved mineral rights are the retention of ownership of all or part of the mineral rights by a person or party conveying land to the United States. Conditions for exercising these rights have been defined in the Secretary's "Rules and Regulations to Govern Exercising of Mineral Rights Reserved in Conveyances to the United States" attached to and made a part of deeds reserving mineral rights.

mitigate: To lessen the severity.

mitigation: Avoiding the impact altogether by not taking a certain action or parts of an action; minimizing impacts by limiting the degree of magnitude of the action and its implementation; rectifying the impact by repairing, rehabilitating, or restoring the affected environment; reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and/or compensating for the impact by replacing or providing substitute resources or environments.

monitoring: Careful observations made over time following reclamation operations to ensure that reclamation goals and objectives and performance standards are being met.

mud system: A system used to manage suspended mud in the well-drilling process (see also closed mud system).

mulch: Non-living or living material placed or left in place on or near the soil surface for the purpose of protecting the soil from erosion and/or for protecting plants from adverse conditions of heat, cold or drought (USDA-FS 1979).

National Environmental Policy Act (NEPA): The federal law established in 1969, which went into effect on January 1, 1970, that 1) established a national policy for the environment, 2) requires federal agencies to become aware of the environmental ramifications of their proposed actions, 3) requires full disclosure to the public of proposed federal actions and a mechanism for public input into the federal decision-making process, and 4) requires federal agencies to prepare an environmental impact statement for every major action that would significantly affect the quality of the human environment.

National Register of Historic Places: A list of districts, sites, buildings, structures, and objects significant in American history, architecture, archaeology, and culture.

new field discovery: A well, usually a wildcat well, that discovers a previously unknown oil and gas field.

No Action alternative: The management direction, activities, outputs, and effects that are likely to exist in the future if the current plan would continue unchanged.

nongame species: Wildlife which is not hunted for recreational purposes.

nonpoint source pollution: Sources from which the pollutants discharges are: 1) induced by natural processes, including precipitation, seepage, percolation, and runoff; 2) not traceable to any discrete or identifiable facility and 3) better controlled through the utilization of Best Management Practices, including process and planning techniques. This includes natural pollution sources not directly or indirectly caused by man.

Notice of Staking: Prior to filing a complete Application for Permit to Drill (APD) an Operator may wish to file a Notice of Staking (NOS). Under this procedure, the site is surveyed and staked, and the onsite inspection is used to provide information to the Operator prior to the Operator committing time and money in preparing an APD which might not reflect agency concerns.

noxious weeds: Officially designated undesirable or invading weedy species generally introduced into an area due to human activity.

off-road vehicle (ORV)/off-highway vehicle (OHV): A vehicle (including four-wheel drive, trail bikes, and snowmobiles but excluding helicopters, fixed-wing aircraft, and boats) capable of traveling off-road over land, water, ice, snow, sand, marshes, and other terrain.

ostracod: Any aquatic crustacean belonging to the subclass *Ostracoda*, characterized by a bivalve, generally calcified carapace with a hinge along the dorsal margin.

pan: A shallow depression, especially containing a lake or pond.

particulates: Small particles in the air and generally considered pollutants.

pediment: A broad gently sloping erosion surface or plain of low relief, typically developed by running water, in an arid or semiarid region, at the base of an abrupt and receding mountain front; it is underlain by bedrock that may be bare but is more often mantled with a thin discontinuous veneer of alluvium derived rom the upland masses and in transit across the surface.

perennial stream: A stream or part of a stream that flows continuously during all of the calendar year as a result of groundwater discharge or surface runoff.

permeability: Extent that a substance is open to passage or penetration, especially by fluids.

permittee (grazing): A person who has livestock grazing privileges on an allotment or allotments within the resource area.

personal income: Includes both monetary and non-monetary forms of income such as medical insurance, private retirement programs and other "fringe" benefits. Usually estimated from administrative records of business and government sources.

pH: The measure of the hydrogen ion concentration. Such measurement indicates the reactive characteristics for water or soil. Low values indicate corrosiveness or acidic conditions that will tend to dissolve metals and other substances. High values indicate alkalinity. A pH of 7.0 indicates neutrality.

piscivorous: Feeding on fishes.

play: An area of anticipated or known oil and gas reserves.

playa: The shallow central basin of a desert plain, in which water gathers after a rain and is evaporated.

population employment ratio: The total population of an area divided by the total number of jobs in that area.

porcellanite: A dense siliceous rock having the texture, dull luster, and general appearance of unglazed porcelain; it is less hard, dense, and vitreous than chert. The term has been used for an impure chert; for a baked clay or shale found in the roof or floor of a burned-out coal seam, and for a fine-grained acidic tuff compacted by secondary silica.

precipitation: As used in hydrology, precipitation is the discharge of water, in liquid or solid state, out of the atmosphere, generally upon a land or water surface.

preferred alternative: The alternative identified in the EIS as the action favored by the agency.

prehistoric site: Archaeologic sites associated with American Indians and usually occurring before contact with Europeans.

prevention of significant deterioration of air quality (PSD): A classification established to preserve, protect, and enhance the air quality in National Wilderness Preservation System areas in existence prior to August 1977 and other areas of National significance, while ensuring economic growth can occur in a manner consistent with the preservation of existing clean air resources. Specific emission limitations and other measures, by class, are detailed in the Clean Air Act (42 U.S.C. 1875 et 15q.).

profile: A vertical section of the soil showing the nature of various horizons in the soil.

proposed species: Any species of fish, wildlife, or plant that is proposed to be listed in the *Federal Register*.

proppants: Proppants or propping agents are substances such as sand or glass beads that are pumped into the formation as part of the fracturing job. The proppants become wedged in the open fractures, leaving channels for oil to flow into the well after the hydraulic fracture pressure is released. This process is often called a "frac job." When high concentrations of acid are used, it may be called an "acid frac job" (see also fracturing/fracing).

public domain minerals: Mineral rights that have always been the property of the United States.

range allotment: A designated area of land available for livestock grazing upon which a specified number and kind of livestock may be grazed under a range Allotment Management Plan. It is the basic land unit used to facilitate management of the range resource on National Forest System and associated lands administered by the Forest Service.

raptor: Living on prey; a group of carnivorous birds consisting of hawks, eagles, falcons, kites, vultures, and owls.

recent in age: Refers to the Holocene epochs of the Quaternary period, from the end of the Pleistocene, approximately 8 thousand years ago, to the present time; also, the corresponding series of rocks and deposits. When the Quaternary is designated as an era, the Holocene is considered to be a period.

reclamation: Rehabilitation of a disturbed area to make it acceptable for designated uses. This normally involves regrading, replacement of topsoil, revegetation and other work necessary to restore it for use.

recreation resources: Formally designated areas and informal dispersed areas that are managed by federal, state and local agencies in order to preserve and further their use for play, amusement, or relaxation.

recurrence interval: 1) the average time interval between actual occurrences of a hydrologic event of a given or greater magnitude; 2) in and annual flood series, the average interval in which a flood of a given size recurs as an annual maximum; and 3) in partial duration series, the average interval between floods of a given size, regardless of their relationship to the year or any other period of time.

reserve pit: 1) Usually an excavated pit that may be lined with plastic, that holds drill cuttings and waste mud. 2) Term for the pit which holds the drilling mud.

revegetation: The re-establishment and development of self-sustaining plant cover. On disturbed sites, human assistance will speed natural processes by seed bed preparation, reseeding and mulching.

rig: Short for drill rig (see drill rig).

right-of-way (ROW): The legal right for use, occupancy, or access across land or water areas for a specified purpose or purposes.

riparian: Land areas which are directly influenced by water. They usually have visible vegetative or physical characteristics showing this water influence. Stream sides, lake borders, or marshes are typical of riparian areas.

riparian area: Geographically delineable areas with distinctive resource values and characteristics that are comprised of the aquatic and riparian ecosystems.

riparian ecosystem: A transition between the aquatic ecosystem and the adjacent terrestrial ecosystem; identified by soil characteristics or distinctive vegetation communities that require free or unbound water.

rip rap: A foundation or erosion control device consisting of rocks thrown together without order.

riverine: Flowing fresh water confined in a channel, with less than 30 percent persistent vegetation cover.

rotenone: A chemical that acts as a sterilizer to harvest all fish species present in a water body in order to introduce or re-introduce a desired species.

runoff: The part of the precipitation event that appears in surface streams.

saline: Containing common salt or any of the salts of alkali metals or magnesium.

scoping: An early and open process for determining the scope of issues to be addressed in an EIS and for identifying the significant issues related to a proposed action. Scoping may involve public meetings, field interviews with representatives of agencies and interest groups, discussions with resource specialists and managers, and written comments in response to news releases, direct mailings, and articles about the proposed action and scoping meetings.

sediment: Soil or mineral transported by moving water, wind, gravity, or glaciers, and deposited in streams or other bodies of water, or on land.

seismic: Pertaining to an earthquake or earth vibration, including those that are artificially induced.

seismic exploration: Seismic exploration is used to map underground geological features to obtain information on the earth's subsurface and to locate areas where accumulations of oil and gas might occur.

Seismic waves, generated at or near the surface, penetrate the earth's crust and reflect from subsurface rock layers back to the surface. The geophysicist receives a printed record or seismograph from which is measured the depth to various strata and from which subsurface structures with a potential for oil and gas accumulation can be determined such as faults, anticlines, and folds.

Portable - Where access limitations, topography, or other restraints prevent use of trucks, portable operations can be performed. Two portable techniques exist for collecting data. These include:

> 1) Surface charge programs involving the detonation of a series of as much as ten, five pound charges of 25-50 pounds of explosives at shot points located at intervals along the seismic line. Surface charges can be placed directly on the ground, on snow, or on a variety of stakes or platforms. All necessary equipment to conduct the operation is transported by helicopter and then conveyed by foot travel.
>
> 2) Various kinds of portable drills can be backpacked or delivered by helicopter to the area. A shallow subsurface portable program would involve drilling a pattern of approximately 16 holes, per mile of line, about 4 inches in diameter and up to 50 feet deep. At this depth, a 10 to 40 pound charge of explosive is placed and detonated. Recording cables and geophones are laid out by foot travel.

With both of these portable techniques, shock waves generated by detonation are received and transmitted via geophones and cable to a recording device. Portable methods are generally used on rough terrain.

Conventional - The conventional method of collecting seismic data includes the use of truck-mounted drills and vehicle-supported crews and generally involves off-road travel. This technique involves drilling 5 to 18, 5-inch diameter holes per mile to a depth of 180 to 200 feet. At this depth, a 10 to 50 pound explosive charge is placed and detonated. Shock waves are received and transmitted via geophones and cable to a truck-mounted recording device.

Vibroseis - The vibroseis technique involves using truck-mounted hydraulic pads which generate energy waves through vibration rather than explosives. The vibrator method typically consists of four large trucks each equipped with a vibrator (a steel slab weighing about three tons mounted between the front and back wheels of a large truck). The vibrator pads (about 4 feet square) are lowered to the ground and the vibrators on the truck are triggered electronically from the recorder truck. Energy waves are received and transmitted via cable and geophones to a recorder truck. After the information is recorded, the trucks move forward a short distance and the process is repeated. The vibroseis operation is usually limited to roads and gentle terrain.

seismic operations: Use of explosive or mechanical thumpers to generate shock waves that can be read by special equipment to indicate subsurface conditions.

sensitive: Species not yet officially listed as rare under the Rare and Endangered Species Act but which are undergoing a status review or are proposed for listing according to Federal Register notices published by the Secretary of the Interior or the Secretary of Commerce or according to comparable state documents published by state officials.

shrub: A woody plant smaller than a tree and having several to many stems.

significant impact: A meaningful standard to which an action may impact the environment. The impact may be beneficial, adverse, direct, indirect, or cumulative, and may have short-term or long-term effects.

silt: Any earthy material composed of fine particles, smaller than sand but larger than clay, suspended in or deposited by water.

snag: Any completely or partially dead trees still standing, at least 10.1cm dbh, and at least 1.8m tall (Thomas et al. 1979).

sodic soil: a soil that has a concentration of sodium ions great enough to adversely affect plant growth. An ESP of 10 percent or greater or an SAR of 10 or greater may indicate the presence of a sodic soil.

sodium absorption ratio (SAR): A laboratory measurement of the ratio of soluble sodium to soluble calcium plus magnesium in soils.

soil: the loose, unconsolidated minerals and organic material on the immediate surface of the ground. Such material serves as the medium for plant growth.

soil productivity: The capacity of a soil to produce a specific crop such as fiber and forage, under defined levels of management. It is generally dependent on available soil moisture, nutrients and length of growing season.

soil stockpile: Piles of surface soil and rocks stored for use in site restoration.

sour well: A condition caused by the presence of hydrogen sulfur compound in an oil or gas well.

special aquatic sites: "Geographic areas, large or small, possessing special ecological characteristics of productivity, habitat, wildlife protection, or other important and easily disrupted ecological values" (40 CFR Section 230.3). Special aquatic sites include sanctuaries and refuges, wetlands, mud flats, vegetated shallows, coral reefs, and pool and riffle complexes (40 CFR Part 230 Subpart E).

species: 1) The classification level of biological nomenclature which categorized each group of related organisms potentially capable of interbreeding; 2) the accepted level of classification to differentiate one specific type of organism from another.

species of concern: Species of concern include federally listed threatened or endangered species, Candidate 1 and 2 species, BLM sensitive species (Rawlins District), and species considered rare or important by the Wyoming Natural Diversity Database (WYNDD).

spp: An abbreviation for the plural of species.

standard lease terms: The basic BLM oil and gas leasing legal document that contains all the basic terms and conditions of the lease and identifies/defines BLM and surface management agency authorities, legal requirements, and general resource protection and mitigation requirements.

stipulation: A legal requirement, specifically a requirement that is part of the terms of a mineral lease. Some stipulations are standard on all federal leases. Other stipulations may be applied to the lease at the discretion of the surface management agency to protect valuable surface resources.

stromatolites: A term for a group of extinct sessile benthic marine organisms of uncertain biological affinities.

stromalitic: Of a rock-like sedimentary structure found in warm, shallow marine habitats; built up from mats of blue-green algae and trapped sediment particles; also found as fossils.

subsidence: 1) The sinking of a large part of the earth's crust or 2) Geologic movement in which there is no free side and the surface material is displaced vertically downward with little or no horizontal component.

succulent: A plant that is fleshy, juicy (i.e., a cactus).

surface lands: Lands consisting of the outside part of the solid earth or ocean as contrasted with subsurface or below surface land use(s) such as drilling and mining.

sweet well: An oil or gas well lacking sulfur and any significant amount of hydrogen sulfide or mercaptans.

tank battery: A group of production tanks that store crude oil in the field.

texture: The relative proportions (by weight) of sand, silt, and clay in a soil material.

threatened and endangered species: Any species, plant or animal, which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its' range. Threatened species are identified by the Secretary of the Interior in accordance with the 1973 Endangered Species Act.

threatened animal species: Any animal species likely to become endangered within the foreseeable future throughout all or a significant part of its range.

threatened plant species: Species of plants that are likely to become endangered within the foreseeable future throughout all or a significant portion of their ranges, including species categorized as rare, very rare, or depleted.

tongue: A minor lithostratigraphic unit of limited extent, especially a member that extends outward beyond the main body of a formation and disappears laterally, usually by facies change.

topography: The features of the earth, including relief, vegetation, and waters.

topsoil: The uppermost layers of naturally occurring soils suitable for use as a plant growth medium.

tuff: A general term for all consolidated pyroclastic rocks.

upland: Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams or between hills.

usable water zones: Usable water is defined as groundwater with a TDS of 10,000 ppm or less encountered at any depth.

ustic: Of limited or intermediate soil moisture levels.

valuation: 1) The act or process of valuing; appraisal of property or 2) the estimated or determined market value of a thing.

vibrator: A steel slab weighing about three tons mounted between the front and back wheels of a large truck. The vibrator pads (about four feet square) are lowered to the ground and the vibrators on the truck are triggered electronically from a recorder truck (see also seismic exploration [vibroseis]).

visual absorption capability (VAC) - A measure of the relative ability of the landscape to absorb visual change. VAC estimates the inherent resistance or susceptibility (vulnerability) to degradation of visual quality.

visual management system: A management system used that establishes the "visual landscape" as a basic resource, treated as an essential part of the land. The visual management system provides a framework to inventory the visual resource and provides measurable standards for management.

visual resource(s): The composite of basic terrain, geologic features, water features, vegetative patterns, and land use effects that typify a land unit and influence the visual appeal the unit may have for visitors.

visual sensitivity levels: An index of the relative degree of user interest in scenic quality and concern and attitude for existing or proposed changes in the landscape features of an area in relation to other areas in the planning unit.

Visual Resource Management (VRM): A system of visual management used by the BLM. The program has a dual purpose: to manage the quality of the visual environment and to reduce the visual impact of development activities while maintaining effectiveness in all Bureau resource programs. VRM also identifies scenic areas that warrant protection through special management attention. The system uses five classes for categorizing visual resources. See also Classes [visual management].

Waters of the U.S.: Include the territorial seas; interstate waters; navigable waterways (such as lakes, rivers, and streams), special aquatic sites, and wetlands that are, have been, or could be used for travel, commerce, or industrial purposes; tributaries; and impoundments of such waters. All channels that carry surface flows and that show signs of active water movement are waters of the U.S. Similarly, all open bodies of water (except ponds and lakes created on upland sites and used exclusively for agricultural activities and aesthetic amenities) are waters of the U.S. (33 CFR § 328.3(a)).

watershed: The entire area that contributes water to a drainage system or stream.

water table: The upper limit of the portion of the ground that is wholly saturated with water.

weathering: The process by which larger particles of soil are reduced to smaller particles by the action of wind, water, temperature, and plant/bacteria action.

wellbore: The diameter of the hole to be drilled.

well pad: Relatively flat work area that contains equipment and facilities used for oil/gas production.

wet deposition: Material in-solution that settles as precipitation (i.e., acid rain).

wetland: Those areas that are inundated or saturated with surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.

wetland hydrology: Includes permanent or periodic inundation or saturation to the soil surface for a significant period during the growing season on a regular basis. Wetland hydrology may be supplied by surface water (i.e., streams), groundwater, and/or direct precipitation. In cases of saturation from inundation, the saturation generally must occur with a 2-year frequency interval, or 50 years out of 100 years. Saturation must occur within 50 percent of the root zone for forb and graminoid species. In addition, saturation must occur for 12.5 percent (approximately 11 consecutive days) of the growing season (Environmental Laboratory 1987).

wildcat well: An exploratory well drilled in an area where there is no oil or gas production (see exploration well).

wildlife: All species of mammals, birds, fish, amphibians, reptiles, and invertebrates found in a wild state.

wildlife habitat: All elements of a wild animal's environment necessary for completion of its life cycle. These elements include food, cover, water, and living space.

wind rose: Any of a class of meteorological diagrams depicting the distribution of wind direction over a period of time.

Windy Gap Process [Decision]: According to the "Windy Gap Decision" of the FWS, any cumulative depletion in flow to the upper basin of the Colorado River System is considered to have a possible effect on the survival and recovery of these listed species.

zone of influence: Those areas surrounding, or associated with, project activities where impacts to a given wildlife species could occur. The shape and extent of such zones varies considerably with species and circumstances.

APPENDICES

APPENDIX A

STANDARD MITIGATION GUIDELINES AND STIPULATIONS FOR SURFACE USE

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1.0 SURFACE DISTURBANCE MITIGATION GUIDELINE

Surface disturbance will be prohibited in any of the following areas or conditions. Exception, waiver, or modification of this limitation may be approved in writing, including documented supporting analysis, by the Authorized Officer (AO).

a. Slopes in excess of 25 percent.

b. Within important scenic areas (Class I and II Visual Resource Management Areas).

c. Within 500 feet of surface water and/or riparian areas, unless there is no practicable alternative as determined by the authorizing officer.

d. Within either one-quarter mile or the visual horizon (whichever is closer) of historic trails.

e. Construction with frozen material or during periods when the soil material is saturated or when watershed damage is likely to occur.

1.1 Guidance

The intent of the SURFACE DISTURBANCE MITIGATION GUIDELINE is to inform interested parties (potential lessees, permittees, or operators) that when one or more of the five (1a through 1e) conditions exist, surface-disturbing activities will be prohibited unless or until a permittee or his designated representative and the surface management agency (SMA) arrive at an acceptable plan for mitigation of anticipated impacts. This negotiation will occur prior to development.

Specific criteria (e.g., 500 feet from water) have been established based upon the best information available. However, such items as geographical areas and seasons must be delineated at the field level.

Exception, waiver, or modification of requirements developed from this guideline must be based upon environmental analysis of proposals (e.g., activity plans, plans of development, plans of operation, applications for permit to drill) and, if necessary, must allow for other mitigation to be applied on a site-specific basis.

2.0 WILDLIFE MITIGATION GUIDELINE

a. To protect important big game winter habitat, activities or surface use will not be allowed from November 15 to April 30 within certain areas encompassed by the authorization. The same criteria apply to defined big game birthing areas from May 1 to June 30.

Application of this limitation to operation and maintenance of a developed project must be based on environmental analysis of the operational or production aspects.

Exception, waiver, or modification of this limitation in any year may be approved in writing, including documented supporting analysis, by the Authorized Officer.

b. To protect important raptor and/or sage and sharp-tailed grouse nesting habitat, activities or surface use will not be allowed from February 1 to July 31 within certain areas encompassed by the authorization. The same criteria apply to defined raptor and game bird winter concentration areas from November 15 to April 30.

Application of this limitation to operation and maintenance of a developed project must be based on environmental analysis of the operation or production aspects.

Exception, waiver, or modification of this limitation in any year may be approved in writing, including documented supporting analysis, by the Authorized Officer.

c. No activities or surface use will be allowed on that portion of the authorization area identified within (*legal description*) for the purpose of protecting (e.g., sage/sharp-tailed grouse breeding grounds, and/or other species/activities) habitat.

Exception, waiver, or modification of this limitation in any year may be approved in writing, including documented supporting analysis, by the Authorized Officer.

d. Portions of the authorized use area legally described as (*legal description*), are known or suspected to be essential habitat for (*name*) which is a threatened or endangered species. Prior to conducting any onsite activities, the lessee/permittee will be required to conduct inventories or studies in accordance with BLM and U.S. Fish and Wildlife Service guidelines to verify the presence or absence of this species. In the event that (*name*) occurrence is identified, the lessee/permittee will be required to modify operational plans to include the protection requirements of this species and its habitat (e.g., *seasonal use restrictions, occupancy limitations, facility design modifications that apply*).

2.1 Guidance

The WILDLIFE MITIGATION GUIDELINE is intended to provide two basic types of protection: 1) seasonal restriction (2a and 2b) and 2) prohibition of activities or surface use (2c). Item 2d is specific to situations involving threatened or endangered species. Legal descriptions will ultimately be required and should be measurable and legally definable. There are no minimum subdivision requirements at this time. The area delineated can and should be defined as necessary, based upon current biological data, prior to the time of processing an application and issuing the use authorization. The legal description must eventually become a part of the condition for approval of the permit, plan of development, and/or other use authorization.

The seasonal restriction section identifies three example groups of species and delineates three similar time frame restrictions. The big game species including elk, moose, deer, antelope, and bighorn sheep; all require protection of crucial winter range between November 15 and April 30. Elk and bighorn sheep also require protection from disturbance from May 1 to June 30, when they typically occupy distinct calving and lambing areas. Raptors include eagles, accipiters, falcons, (peregrine, prairie, and merlin), kestrels, buteos (ferruginous and Swainson's hawks), osprey, burrowing owls, and short-eared owls. The raptors and sage and sharp-tailed grouse require nesting protection between February 1 and July 31. The same birds often require protection from disturbance from November 15 through April 30 while they occupy winter concentration areas.

Item 2c, the prohibition of activity or surface use, is intended for the protection of specific wildlife habitat areas or values within the use area that cannot be protected by using seasonal restrictions. These areas or values must be factors that limit life-cycle activities (e.g., *sage grouse strutting grounds, known threatened and endangered species habitat*).

Exception, waiver, or modification of requirements developed from this guideline must be based upon environmental analysis of proposals (e.g., activity plans, plans of development, plans of operation, applications for permit to drill) and, if necessary, must allow for other mitigation to be applied on a site-specific basis.

3.0 CULTURAL RESOURCE MITIGATION GUIDELINE

When a proposed discretionary land use has potential for affecting the characteristics which qualify a cultural property for the National Register of Historic Places (National Register), mitigation will be considered. In accordance with Section 106 of the Historic Preservation Act, procedures specified in 36 CFR 800 will be used in consultation with the Wyoming State Historic Preservation Officer and the Advisory Council on Historic Preservation in arriving at determinations regarding the need and type of mitigation required.

3.1 Guidance

The preferred strategy for treating potential adverse effects on cultural properties is "avoidance." If avoidance involves project relocation, the new project area may also require cultural resource inventory. If avoidance is imprudent or unfeasible, appropriate mitigation may include excavation (data recovery), stabilization, monitoring, protection barriers and signs, or other physical and administrative measures.

Reports documenting results of cultural resource inventory, evaluation, and the establishment of mitigation alternatives (if necessary) shall be written according to standards contained in BLM Manuals, the cultural resource permit stipulations, and in other policies issued by the BLM. These reports must provide sufficient information for Section 106 consultation. Reports shall be reviewed for adequacy by the appropriate BLM cultural resource specialist. If cultural properties on, or eligible for, the National Register are located within these areas of potential impact and cannot be avoided, the Authorized Officer shall begin the Section 106 consultation process in accordance with the procedures contained in 36 CFR 800.

Mitigation measures shall be implemented according to the mitigation plan approved by the BLM Authorized Officer. Such plans are usually prepared by the land use applicant according to BLM specifications. Mitigation plans will be reviewed as part of Section 106 consultation for National Register eligible or listed properties. The extent and nature of recommended mitigation shall be commensurate with the significance of the cultural resource involved and the anticipated extent of damage. Reasonable costs for mitigation will be borne by the land use applicant. Mitigation must be cost effective and realistic. It must consider project requirements and limitations, input from concerned parties, and be BLM-approved or BLM-formulated.

Mitigation of paleontological and natural history sites will be treated on a case-by-case basis. Factors such as site significance, economics, safety, and project urgency must be taken into account when making a decision to mitigate. Authority to protect (through mitigation) such values is provided for in Federal Land Policy Management Act (FLPMA) (1976), Section 102(a)(8). When avoidance is not possible, appropriate mitigation may include excavation (date recovery), stabilization, monitoring, protection barriers and signs, or other physical and administrative protection measures.

4.0 SPECIAL RESOURCE MITIGATION GUIDELINE

To protect (*resource value*), activities or surface use will not be allowed (i.e., *within a specific distance of the resource value or between date to date*) in (*legal description*).

Application of this limitation to operation and maintenance of a developed project must be based on environmental analysis of the operational or production aspects.

Exception, waiver, or modification of this limitation in any year may be approved in writing, including documented supporting analysis, by the Authorized Officer.

4.1 Example Resource Categories (*Select or identify category and specific resource value*):

a. Recreation areas.

b. Special natural history or paleontological features.

c. Special management areas.

d. Sections of major rivers.

e. Prior existing rights-of-way.

f. Occupied dwellings.

g. Other (specify).

4.2 Guidance

The SPECIAL RESOURCE MITIGATION GUIDELINE is intended for use only in site-specific situations where one of the first three general mitigation guidelines will not adequately address the concern. The resource value, location, and specific restrictions must be clearly identified. A detailed plan addressing specific mitigation and special restrictions will be required prior to disturbance or development and will become a condition for approval of the permit, plan of development, or other use authorization.

Exception, waiver, or modification of requirements developed from this guideline must be based upon environmental analysis of proposals (e.g., activity plans, plans of development, plans of operation, applications for permit to drill) and, if necessary, must allow for other mitigation to be applied on a site-specific basis.

5.0 NO SURFACE OCCUPANCY GUIDELINE

No Surface Occupancy (NSO) will be allowed on the following described lands (*legal description*) because of (*resource value*).

5.1 Example Resource Categories (*Select or identify category and specific resource value*):

a. Recreation areas (e.g., campgrounds, historic trails, national, monuments).

b. Major reservoirs/dams.

c. Special management areas (e.g., areas of critical environmental concern, known threatened or endangered species habitat, wild and scenic rivers).

d. Other (specify).

5.2 Guidance

The NO SURFACE OCCUPANCY (NSO) MITIGATION GUIDELINE is intended for use only when other mitigation is determined insufficient to adequately protect the public interest and is the only alternative to "no development" or "no leasing." The legal description and resource value of concern must be identified and be tied to an NSO land use planning decision.

Waiver of, or exception(s) to, the NSO requirement will be subject to the same test used to initially justify its imposition. If, upon evaluation of a site-specific proposal, it is found that less restrictive mitigation would adequately protect the public interest or value of concern, then a waiver or exception to the NSO requirement is possible. The record must show that because conditions or uses have changed, less restrictive requirements will protect the public interest. An environmental analysis must be conducted and documented (e.g., environmental assessment, environmental impact statement, etc., as necessary) in order to provide the basis for a waiver or exception to an NSO planning decision. Modification of the NSO requirement will pertain only to refinement or correction of the location(s) to which it applied. If the waiver, exception, or modification is found to be consistent with the intent of the planning decision, it may be granted. If found inconsistent with the intent of the planning decision, a plan amendment would be required before the waiver, exception, or modification could be granted.

When considering the "no development" or "no leasing" option, a rigorous test must be met and fully documented in the record. This test must be based upon stringent standards described in the land use planning document. Since rejection of all development rights is more severe than the most restrictive mitigation requirement, the record must show that consideration was given to development subject to reasonable mitigation, including "no surface occupancy." The record must also show that other mitigation was determined to be insufficient to adequately protect the public interest, a "no development" or "no leasing" decision should not be made solely because it appears that conventional methods of development would be unfeasible, especially where an NSO restriction may be acceptable to a potential permittee. In such cases, the potential permittee should have the opportunity to decide whether or not to go ahead with the proposal (or accept the use authorization), recognizing that an NSO restriction is involved.

6.0 BUREAU OF RECLAMATION (BOR) STIPULATIONS FOR SURFACE USE (Oil and Gas Well Drill Sites and Access Roads)

1) Reserve pits shall be in cut.

2) Reserve pits shall be lined with a 12-mil nylon reinforced plastic liner. If a rock outcrop is encountered during construction of a pit, a geotextile fiber liner shall be placed under the plastic liner.

3) Reserve pits shall be fenced stock tight on three sides during drilling operations, shall be fenced on the fourth side between phases (i.e., from drilling to completion phases), and shall be fenced on all four sides until backfilled.

4) Pumping units and/or compressor units shall have a muffler installed for noise control.

5) Tank batteries shall be bermed to one and one-half times the capacity of the tanks.

6) Portable chemical toilets shall be placed on the site for all phases of drilling and surface facilities completion.

7) Water wells shall not be allowed to reside in any developed campgrounds or undeveloped areas of the Seedskadee Project.

8) Construction crews shall not be allowed to reside in any developed campgrounds or undeveloped areas of the Seedskadee Project.

9) Low water crossings with 4:1 approaches shall be constructed in and out of any such crossing on existing roads to be upgraded and on any new road construction. A layer of six to eight inches of gravel shall be placed on all 4:1 approaches.

10) Cattle guards and culverts shall be installed as needed on existing roads to be upgraded and on the newly constructed roads.

11) Existing roads and newly constructed roads shall be kept maintained to the satisfaction of the BOR.

12) Revegetation shall be as directed by the Bureau of Land Management (BLM).

13) Surface facilities shall be painted as directed by BLM.

14) During rehabilitation, the location shall be contoured as close as possible to its original shape.

15) The BOR shall be notified 72 hours after rehabilitation of the well location, for an on-site compliance inspection.

APPENDIX B

RECLAMATION GUIDELINES

Expanded Moxa Arch Area Natural Gas Development Project

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APPENDIX B

RECLAMATION GUIDELINES

1.0 INTRODUCTION

The following erosion control, revegetation, and management guidelines are designed to attain successful rehabilitation of disturbed areas associated with the Expanded Moxa Arch Area Natural Gas Development Project (Moxa). These recommended measures are designed to establish the feasibility of successfully reclaiming disturbances associated with this project. These guidelines were developed based on 1) Bureau of Land Management (BLM) Wyoming State Office reclamation policy (USDI-BLM 1990), 2) management directives presented in the Kemmerer Resource Area Resource Management Plan (RMP) (USDI-BLM 1986), 3) Executive Order 11987, 4) impacts identified in the Environmental Consequences chapter (Chapter 4) of this environmental impact statement (EIS), 5) coordination with BLM staff in the Kemmerer and Rock Springs offices as well as with Amoco (Sundberg 1994), and 6) through issues identified during the scoping process. In addition to Chapter 4 of this EIS, environmental characterization and details that relate to reclamation feasibility are presented in the Soils and Water Resources Technical Report (ECOTONE 1995a) and the Vegetation and Wetlands Technical Report (ECOTONE 1995b). These guidelines were prepared by ECOTONE Environmental Consulting, Inc. of Logan, Utah specifically for the conditions of the Moxa project area and the objectives identified in Section 2.0 - Objectives.

The extent of possible disturbed areas to be reclaimed include the drill sites, access roads and pipeline rights-of-way (ROW), and staging areas. The following guidelines apply to the Proposed Action, Alternative A, and the "No Action" Alternative. The measures presented in this appendix are designed to allow the project to be constructed without significant impacts to natural resources including soils, watershed, vegetation, and wildlife habitat. Because of the large geographic area covered by the project, 476,261 acres, these measures are presented in a general, non-project facility specific manner. Final selection of the measures to be applied at any given location, and modifications of these measures, will be identified by the BLM in coordination with the Amoco and other project operators (Operators) during the process of reviewing and approving each Application for Permit to Drill (APD).

This appendix provides reclamation guidelines only and therefore, is *not* a reclamation plan. These guidelines should be applied to all lands disturbed in the Moxa project area. However, the BLM cannot require that these guidelines be applied to State and other private lands within the Moxa project area. The land manager and/or the land owner of State and private lands will determine the reclamation measures to be applied on those lands. The land manager and/or the land owner should find these guidelines to be appropriate for such lands.

On BLM administered lands, the final reclamation measures that would be applied should be based upon site-specific conditions and validation of these measures upon the approval of, and in agreement with, the BLM Authorized Officer (AO) during the APD review process. These guidelines describe how drilling activities should be managed to assure compliance with the resource management goals and objectives for the general area, applicable lease and unit area stipulations, and resource limitations identified during interdisciplinary (ID) team analyses. ***If deemed necessary in light of new facts (e.g., effectiveness of specific measures, cost feasibility, and/or availability of materials and supplies, etc.) or to minimize impacts, the following measures may be applied where and when needed, added to, modified, or selectively withheld by the Operators in agreement and consultation with the BLM AO.*** Initial monitoring for compliance and successful implementation of the mitigation measures will be under the direction of the operator. Final approval and release will be under the direction of the BLM AO on federally-managed lands.

Reclamation measures covered in this appendix fall into two general categories: temporary and final reclamation. Temporary reclamation refers to measures applied to stabilize disturbed areas and to control runoff and erosion during time periods when application of final reclamation measures is not feasible or practicable. Final reclamation refers to measures that should be applied concurrently with completion of drilling and pipeline installation.

Reclamation potential (as described in detail by ECOTONE (1995a)) may be limited by salinity, alkalinity, steep slopes, shallow soils, shallow depth to bedrock, low precipitation, stoniness, non-cohesive soils, high wind and water erosion, periodic flooding, short growing season, seasonably high water tables, and strong winds. Intensive land-use practices may be necessary to mitigate salt and sediment loading caused by surface-disturbing activities. Activity plans (e.g., applications for permit to drill (APDs)) should address site-specific problems, including monitoring for salt and sediment loading (USDI-BLM 1986).

In general, temporary reclamation measures should be applied to all areas not promptly reclaimed to final conditions within a specified time period whether due to adverse weather conditions, inability to secure needed materials, and/or seasonal constraints, etc. Temporary reclamation measures should be applied only as needed; as in most cases, final reclamation measures should be applied concurrently as sections of the project are completed. Temporary reclamation measures may be applied more rigorously to sensitive areas such as drainage channel crossings, steep slopes, and areas prone to high wind and water erosion. Temporary reclamation measures should include regrading the disturbed area to near predisturbance contour, respreading salvaged topsoil, mulching, and placing runoff and erosion control structures.

Final reclamation measures, in general, involve regrading the disturbed area to near predisturbance contour, respreading salvaged topsoil, applying soil amendments and protective materials (e.g., straw mulch, fertilizers, etc), if necessary, applying a prescribed seed mixture, and placing runoff and erosion control structures such as water bars and silt fences. The duration of the resultant impacts to the various vegetation community types depends in part on the success of implementation of the reclamation measures prescribed in this appendix and the time required for natural succession to return disturbed areas to predisturbance conditions after project completion.

Because wetlands are "waters of the U.S." and are therefore protected under the federal Clean Water Act (CWA), discharge of dredge or fill material into, and/or excavation of wetlands could require administrative coordination with the U.S. Army Corps of Engineers (COE) pursuant to the CWA and may require a Section 404 permit. The COE, based on the exact nature of the disturbance activity should determine the type of permit (Individual, Regional, or Nationwide) required according to the rules and regulations presented in the Federal Register (1986). Avoidance of waters of the U.S. and wetlands should be the highest priority in the planning process. A suitable wetland mitigation plan should be developed based on these guidelines for the areas of wetlands directly impacted due to project activities where avoidance is not practicable. Impact minimization should include reducing the area of disturbance in wetland areas as well as utilizing procedures specified by authorizing agencies to cross intermittent and ephemeral drainage channels and wetland areas.

Although most intermittent and ephemeral drainage channels are not considered wetlands, the same requirements apply to the discharge of dredge and fill into these surface waters as for discharge into wetlands (see ECOTONE 1995a and b). Residual wetland impacts that could occur after maximum avoidance and/or impact minimization has been demonstrated should be mitigated according to the following order of priority: 1) avoidance; 2) impact minimization; 3) mitigation in-kind, on-site; 4) mitigation in-kind, off-site; 5) mitigation out-of-kind, on-site; and 6) mitigation out-of-kind, off-site. In addition, the following modes of mitigation could be implemented for wetland mitigation if avoidance and impact minimization were not feasible: 1) wetlands restoration; 2) wetlands creation; and 3) wetlands enhancement. The wetlands mitigation plan should be designed to replace the area of impact and functional values associated with the disturbed area.

2.0 OBJECTIVES

This appendix is designed to meet the following objectives for reclamation of access road/pipeline ROWs and drill sites:

Short-Term (Temporary) Reclamation:

- Immediately stabilize the disturbed areas by mulching (if needed), providing runoff and erosion control, and through the initiation of new vegetation (required for problem areas; may be optional for other areas depending on consultation with the BLM).
- Control and minimize surface runoff, erosion, and sedimentation through the use of diversion and water treatment structures.
- Facilitate the re-establishment of desired native plant communities.

Long-Term (Final) Reclamation:

- Immediately stabilize the disturbed soil surface by mulching (if needed and as directed by the BLM), runoff and erosion control, and through the initiation of protective vegetation. Adequate surface roughness should exist to reduce runoff and to capture rainfall and snow melt.
- Control and minimize surface runoff, erosion, and sedimentation through the use of diversion and water treatment structures.
- Restore primary productivity of the site and establish vegetation that will provide for natural plant and community succession.
- Re-establish desired native plant communities.
- Establish a vigorous stand of desirable native plant species that will limit or preclude invasion of undesirable species, including noxious weeds.
- Revegetate the disturbed areas with plant species useful to wildlife and livestock.

- Enhance aesthetic values of disturbed areas to blend with surrounding undisturbed areas. In the long-term, reclaimed landscapes should have characteristics that approximate the visual quality of adjacent areas, including location, scale, shape, color, and orientation of major landscape features.

3.0 PERFORMANCE STANDARDS

The following performance standards should be used to determine the attainment of successful revegetation. Performance monitoring should follow the guidelines presented in the attachment to this appendix.

All Years:

- Protective cover - with the exception of active work areas, all disturbed highly erosive or sensitive areas to be left bare, unprotected, or unreclaimed for more than one month will have a protective cover of suitable material in the form of mulch, matting, or vegetative growth. All other disturbed areas should have an effective protective cover within six months.

Third Year (Final Reclamation):

- Seedling density - the density and abundance of desirable species is at least three to four seedlings per linear foot of drill row (if drilled) or transect (if broadcast) for most areas. In some sparsely vegetated areas such as badlands and sodic and saline/alkaline bottomlands, this standard can be reduced to one to two seedlings per foot to be commensurate with the naturally low vegetal cover, unless significant surface erosion is anticipated. Vegetative transects will be established on a permanent basis so that transects can be measured annually through the five year monitoring period.

- Percent cover - total vegetal cover will be at least 50 percent of predisturbance vegetal cover as measured along the reference transect for establishing baseline conditions.

By the Fifth Year (Final Reclamation):

- Percent cover - total vegetal cover will be at least 80 percent of predisturbance vegetal cover as measured along the reference transect for establishing baseline conditions.

- Dominant species - 90 percent of the revegetation consists of species included in the seed mix and/or occurs in the surrounding natural vegetation, or as deemed desirable by the BLM as measured along the reference transect for establishing baseline conditions.

- Erosion condition/soil surface factor - erosion condition of the reclaimed areas is equal to or in better condition than that measured for the reference transect for establishing baseline conditions.

4.0 METHODS

4.1 Drill Site, Access Road, and Pipeline Right-of-Way Clearing and Topsoil Removal and Storage

In general, topsoil should be handled separately from subsoil materials. At all construction sites, topsoil should be stripped and salvaged to provide for sufficient quantities to be respread to a depth of at least four to six inches (or more if readily available on-site) over the disturbed areas to be reclaimed. In areas where deep soils exist (such as floodplains and drainage channel terraces), at least 12 inches of topsoil should be salvaged. Where soils are shallow to bedrock or have a stony subsoil, topsoil should be salvaged as specified by the AO. Topsoil should be stockpiled separately from subsoil materials. Topsoil salvaged from drill sites and stored for more than one year (under unusual circumstances) should be transported to a specified location at the margin of these sites, graded to a depth not greater than 24 inches to maintain topsoil viability, seeded with a prescribed seed mixture, and covered with mulch for protection from wind and water erosion and to discourage the invasion of weeds. Topsoil should be stockpiled separately from other earth materials to preclude contamination or mixing and should be marked with signs and identified on Construction and Design plans. Runoff should be diverted around topsoil stockpiles to minimize erosion of topsoil materials. In most cases, disturbances will be reclaimed within one year. Therefore, it is unlikely that topsoil stockpiling for more than one year will be required. Salvaged topsoil from roads and drill sites will be respread over cut-and-fill surfaces not actively used during the production phase. Upon final reclamation at the end of the project life, topsoil spread on these surfaces will be used for the overall reclamation effort.

Operators are finding out that it is not always necessary to remove all vegetation and strip all topsoil within a pipeline ROW except over the area of the trench where soil and subsoil has been excavated. Topsoil up to 12 inches deep should be removed, salvaged, and respread over the excavated trench area. In many areas, such as with deep soils on relatively flat smooth slopes with low gradients, it is possible to crush in-place rather than clear vegetation and leave topsoil in-place rather than blade and stockpile. This technique would reduce the magnitude and severity of disturbance impacts and hasten successful reclamation.

In federal jurisdictional wetland areas, vegetation should be cut off only to the ground level, leaving existing root systems intact. Cut vegetation should be removed from wetland areas for disposal. Grading activities should be limited to directly over pipeline trenches and access roads. At least 12 inches of topsoil should be salvaged and replaced except in areas with standing water or saturated soils. Use of construction equipment in wetland areas should be limited. Dirt, rockfill, or brush riprap should not be used to stabilize pipeline ROWs. If standing water or saturated soils are present, wide-track or balloon-tire construction equipment should be used or normal construction equipment should be operated on equipment pads or geotextile fabric overlain with gravel fill. Equipment pads etc., should be removed immediately upon completion of construction activities. Trench spoil should be placed at least 10 feet away from drainage channel banks for all minor and major drainage channel crossings.

4.2 Drill Site, Access Road, and Pipeline Right-of-Way Construction

4.2.1 Upland Areas

Uplands include all areas away from wetlands and alluvial bottomlands or other areas that have excess soil moisture for prolonged periods or have shallow water tables. Construction should be accomplished following site-specific Construction and Design plans and applicable agency specifications. At drill sites, and along the areas of access road or pipeline ROW traversing steep slopes, slope angles should be minimized to enhance retention of topsoil, and reduce erosion as well as facilitate revegetation, and subsequent reclamation success. Slope stabilizing revetment structures may be necessary in areas where the substrata materials are unconsolidated and loose and cannot be stabilized with revegetation and mulch.

Surface runoff should be controlled at all well sites through the use of interception ditches and berms. A berm approximately 18 inches high should be constructed around fill portions of these well sites to control and contain all surface runoff generated or fuel or petroleum product spills on the pad surface. Water contained on the drill pads should be treated in a detention pond prior to discharge into undisturbed areas in the same manner as discussed previously. This system should also serve to capture fuel and chemical spills, should they occur.

Erosion and sedimentation control measures and structures, as approved by the AO, should be installed on all disturbed areas. Soil erosion control should be accomplished on sites in highly erosive soils and steep areas, as needed, with mulching, netting, tackifiers, hydromulch, matting, and excelsior. The type of control measure should depend on slope gradients and the susceptibility of soil to wind and water erosion. Silt fences should be placed at the base of all steep fill slopes and sensitive disturbed areas. All runoff and erosion control structures should be inspected periodically, cleaned out, and maintained in functional condition throughout the duration of construction and drilling. Water bars should be constructed on cut-and-fill slopes exceeding 25 feet long and 10 percent gradient using the water bar spacing guidelines and procedures specified for access road and pipeline ROW runoff and erosion control.

Runoff and erosion control along access road/pipeline ROWs should be accomplished by implementing standard cross drain, culvert, road ditch, and turnout design as well as timely mulching and revegetation of exposed cut, fill, and road shoulders. All culverts should be constructed with riprapped entrances and exits and with energy dissipators or other scour- reducing techniques as needed and where appropriate. Water discharged from culverts, cross drains, road ditches and turnouts should be directed into undisturbed vegetation away from all natural drainages. Erosion and sedimentation control measures and structures, as approved by the AO, should be installed across all cut-and-fill slopes within 100 feet of drainage channels. All runoff and erosion control structures should be inspected after major runoff events and at a regular schedule. If found to be sub-standard, these structures should be cleaned out and maintained in functional condition throughout the life of the project.

4.2.2 Drainage Channel Crossings

Construction of all drainage channel crossings should minimize the disturbance to drainage channels and wetlands to the extent practicable and should occur during the low runoff period (June 15 through March 1), or as directed by the AO. Staging areas, if used for a given crossing, should be limited in size to the minimum necessary and should be located at least 50 feet from drainage channel bottoms (or greater if in wetlands), where topographic conditions permit. Drainage channel crossings should be constructed as perpendicular to the axis of the drainage channel and at the narrowest positions as engineering and routing conditions permit. Clean gravel should be used for the upper one foot of fill over the backfilled pipeline trenches in perennial and intermittent streams. Silt fences or other sediment filtering devices such as weed-free straw bales should be installed at drainage channel banks where sedimentation is excessive and at the base of all slopes adjacent to wetlands.

Trench plugs should be employed during pipeline construction at non-flumed drainage crossings to prevent diversion of drainage channel flows into upland portions of pipeline trenches during construction. Application of riprap should be limited to areas where flow conditions prevent vegetative stabilization; riprap activities must comply with COE permit requirements. Pipeline trenches should be dewatered in such a manner that no silt laden water flows into active drainage channels (i.e., prior to discharge the water will be filtered through a silt fence, weed-free straw bales, or allowed to settle in a sediment detention pond).

After the completion of construction, all areas where soil has been disturbed that are not part of the actual road should be revegetated according to the revegetation specifications subsequently described. Where vegetation is disturbed, temporary sediment barriers such as silt fences and/or staked weed-free straw bales should be installed along the topographic contour at the base of the slope adjacent to the road crossing. Temporary sediment barriers should remain in-place until permanent revegetation measures have been judged successful by the AO.

4.2.3 Wetlands and Alluvial Bottomlands

Access roads and pipelines should be rerouted, and drill sites located, to avoid these areas to the maximum extent practicable. RMP management directives require a 500-foot setback from perennial streams and live water. The size of staging areas should be limited to the minimum necessary and all staging areas should be located out of these areas unless such avoidance is not practicable. Where avoidance is not practicable, staging areas should be located at least 50 feet from the edge of wetland areas, where topographic conditions permit. The width of the access road and pipeline construction ROW should be limited to no more than 50 feet. Hazardous materials should not be stored and equipment should not be refueled within 100 feet of wetland boundaries. Appropriate permits should be secured from the COE prior to any construction activities in federal jurisdictional wetland areas.

4.3 Surface Runoff and Erosion Control

4.3.1 Drill Site, Access Road, and Pipeline Right-of-Way

4.3.1.1 Temporary Reclamation

Temporary erosion control measures, where needed, may include application of mulch and netting of biodegradable erosion control blankets stapled firmly to the soil surface, respreading scalped vegetation, construction of water bars, application of soil stabilizers or tackifiers, use of a standing crop of an annual grain (e.g., sterile barley), or other procedures as directed by the AO. See Final Reclamation measures for specific information pertaining to mulching.

The actual distance of a pipeline/road ROW requiring stabilization on each side of a drainage channel should be determined on a site-specific basis as directed by the AO. To minimize sedimentation of drainage channels and wetlands during the interim period between construction activity and final reclamation, temporary erosion and sediment control measures should be applied. Silt fences or other sediment filtering devices such as weed-free straw bales should be installed at drainage channel banks where sedimentation is excessive and at the base of all slopes adjacent to wetlands. These structures should be keyed into the soil to prevent surface water from going under or around the structure. This includes excavating a shallow trench and burying the bottom of the structures. Where straw bales are used, they should be reinforced by pounding re-bar through the bales and into the soil. Exhibit B-1 presents schematics of water bar and silt fence construction. Sediment filtering devices should be cleaned out and maintained in functional condition throughout the life of the project. To avoid the possibility of mulching materials entering waterways, loose mulch (i.e., mulch not crimped into the soil surface, tackified, or incorporated into erosion control blankets) should not be applied to drainage channel banks.

If construction is completed prior to the specified seeding season for perennial vegetation, areas adjacent to the larger drainage channels should be covered with jute matting for a minimum of 50 feet on either side of the drainage channel. In addition, to protect soil from raindrop impact and subsequent erosion, 2.0 tons/acre of a weed-free straw mulch should be applied to all slopes greater than 10 percent. Temporary erosion control measures may include leaving the ROW in a roughened condition, respreading scalped vegetation, or applying mulch as specified by the AO.

As indicated by several operators and the BLM, weed-free straw mulch is difficult to obtain in quantities and at costs suitable for all reclamation applications. Although this circumstance could reduce the application of the measure, the effectiveness of mulch in protecting the exposed soil from raindrop impact, erosion, and off-site sedimentation should not be ignored. As discussed in the Soils and Water Resources Technical Report (ECOTONE 1995a), the effective application of mulch can reduce soil erosion by as much as 900 percent. In addition to its effectiveness in erosion control, mulching also benefits the soil as a plant growth medium in most cases. Therefore, effective mulching is fundamental to reducing soil erosion to acceptable, non-significant levels.

Trench breakers should be used for pipeline construction in certain areas to prevent the flow of water in either a trench that has been backfilled or temporarily left open. Trench breakers are particularly important in wetland areas to minimize subsurface drainage. Trench breakers should be constructed such that the bottom of one breaker is at the same elevation as the top of the next breaker down slope, or every 50 feet, whichever is greater. Factors that control the application of trench breakers include the proximity to drainage channels and wetland areas, slope gradient, proximity of areas to shallow groundwater, and surface runoff source areas that can discharge water into the trench. Trench breakers should be installed, where necessary, as directed by the AO. Topsoil should not be used to construct trench breakers.

If a pipeline crosses roads at the base of slopes, vegetative strips should be maintained. If vegetation is disturbed within these limits, temporary sediment barriers such as silt fences and/or staked weed-free straw bales should be installed at the base of the slope adjacent to the road crossing. Temporary sediment barriers should remain in-place until permanent revegetation measures have been judged successful by the AO.

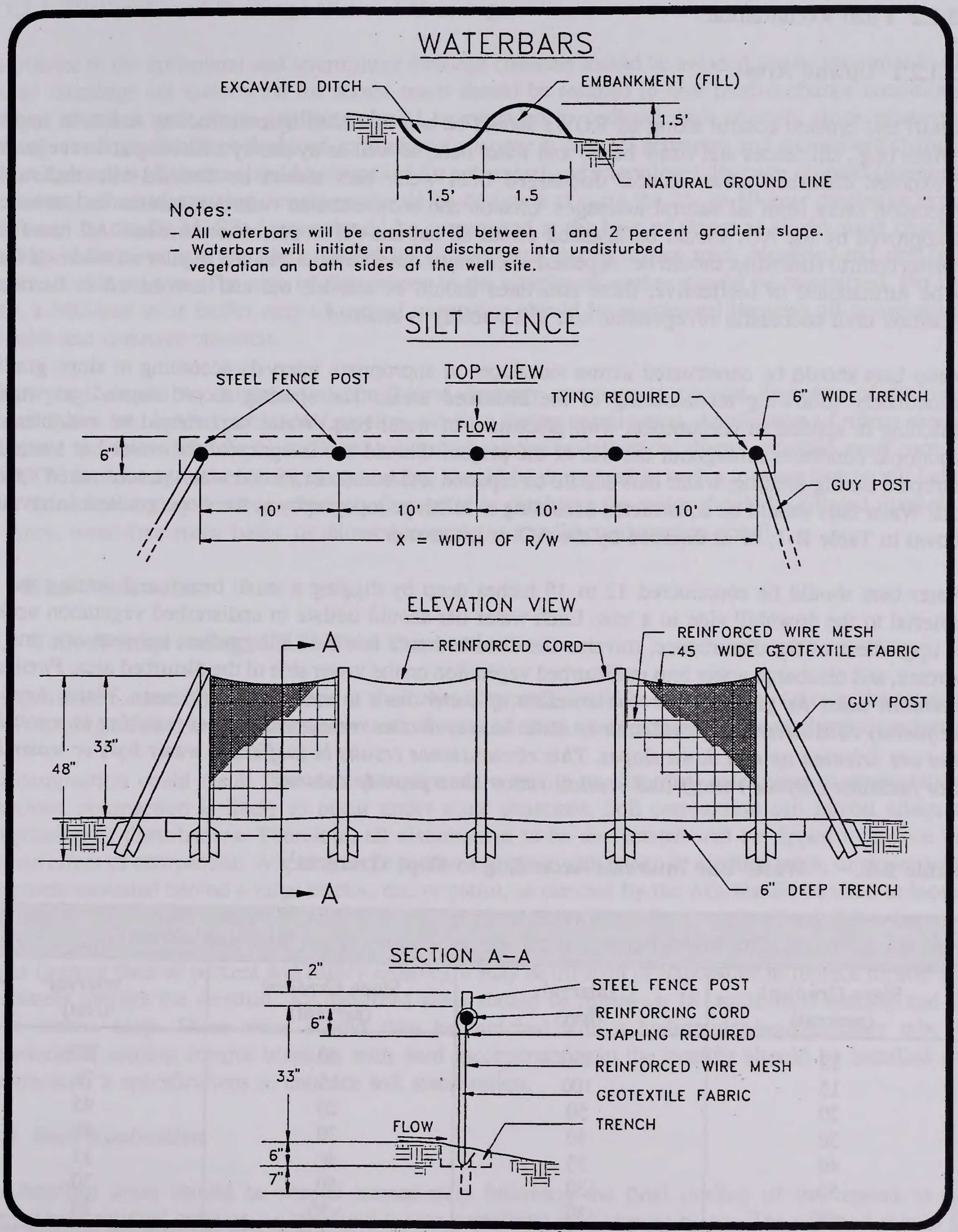

Exhibit B-1. Water Bar Construction and Silt Fence Construction.

4.3.1.2 Final Reclamation

4.3.1.2.1 Upland Areas

Runoff and erosion control along all ROWs should be accomplished by constructing sediment trapping devices (e.g., silt fences and straw bales) and water bars, as well as by timely mulching and revegetation of exposed disturbed areas. Runoff discharged from water bars should be directed into undisturbed vegetation away from all natural drainages. Erosion and sedimentation control measures and structures, as approved by the AO, should be installed across all cut-and-fill slopes, where needed. All runoff and erosion control structures should be inspected after major runoff events and at a regular schedule. If found to be substandard or ineffective, these structures should be cleaned out and maintained in functional condition until successful revegetation and soil stability is attained.

Water bars should be constructed across sideslopes at appropriate intervals according to slope gradient immediately following recontouring of the disturbed areas. The spacing should depend on whether mulching is applied in conjunction with placement of water bars. Water bars should be maintained in functional condition throughout the life of the project. Should the integrity of the water bar system be disrupted during seeding, water bars should be repaired and broadcast seeded with the seed raked into the soil. Water bars should be constructed according to hillslope topography at the slope gradient intervals as shown in Table B-1, or as directed by the AO or landowner.

Water bars should be constructed 12 to 18 inches deep by digging a small trench and casting the soil material to the downhill side in a row. Each water bar should initiate in undisturbed vegetation upslope or upgradient of the disturbance, traverse the disturbed area at a side hill gradient between one and two percent, and discharge water into undisturbed vegetation on the lower side of the disturbed area. ***Particular attention must be given to the construction of water bars to ensure effectiveness. Water bars are frequently constructed perpendicular to disturbances that traverse across slopes resulting in water bars that are oriented up and down slopes. This circumstance results in ineffective water bars or water bars that facilitate surface runoff and erosion rather than provide control.***

Table B-1. Water Bar Intervals According to Slope Gradient[1].

With Mulching		Without Mulching	
Slope Gradient (percent)	**Interval (feet)**	**Slope Gradient (percent)**	**Interval (feet)**
10	150	10	100
15	100	15	75
20	50	20	45
30	40	30	40
40	35	40	35
50	30	50	30
>50	30	>50	30

1 - Based on Grah (1989).

4.3.1.2.2 Wetlands and Drainage Channel Crossings

Disturbance to the ephemeral and intermittent drainage channels should be avoided and/or minimized. All channel crossings not maintained for access roads should be restored to near predisturbance conditions. Drainage channel bank slope gradients should be regraded to conform with adjacent slope gradients. Channel crossings should be designed to minimize changes in channel geometry and subsequent changes in flow hydraulics. Culverts should be installed for ephemeral and intermittent drainage channel crossings. All drainage channel crossing structures should be designed to carry the 25- to 50-year discharge event as directed by the BLM. Silt fences should be constructed at the base of slopes at all drainage channel crossings. Minor routing variations should be implemented during access road, pipeline, and drill site layout to avoid washes. The area of disturbance in the vicinity of washes should be minimized. Per the RMP, a 500-foot-wide buffer strip of natural vegetation should be maintained between all construction activities and drainage channels.

Trench plugs should be employed at non-flumed drainage crossings to prevent diversion of drainage channel flows into upland portions of pipeline trenches during construction. Application of riprap should be limited to areas where flow conditions prevent vegetative stabilization; riprap activities must comply with COE permit requirements. Pipeline trenches should be dewatered in such a manner that no silt laden water flows into active drainage channels (i.e., prior to discharge the water should be filtered through a silt fence, weed-free straw bales, or allowed to settle in a sediment detention pond).

4.4 Final Reclamation

4.4.1 Topsoil Respreading and Seedbed Preparation

In preparation for seeding, at least four to six inches of topsoil should be evenly respread over the pipeline ROW, staging areas, cut-and-fill surfaces, and all areas of other sites not required for production purposes.

Soil compaction could result from heavy equipment working on disturbed soils prior to revegetation. Therefore, compaction is likely to occur under most situations. Soil compaction can inhibit adequate revegetation of disturbances. Therefore, all disturbances to be revegetated will be ripped to reduce the adverse effect of compaction. A spring tooth harrow equipped with utility or seedbed teeth, or ripper-teeth equipment mounted behind a large tractor, cat, or patrol, as directed by the AO, should be used to loosen the subsoil. The subsoil surface should be left rough. After topsoil has been respread and if it is loose, it should be lightly compacted with a cultipacker or similar implement to provide a firm seedbed. On steep slopes (greater than 40 percent and highly erosive), it may be difficult or impossible to replace topsoil and adequately prepare the seedbed. All disturbed areas should be ripped on 18- to 26-inch spacing and 12 to 16 inches deep. These areas should then be mulched with a hydromulch/seed/tackifier mix. If implemented, erosion control blankets with seed incorporated into the matting should be installed per manufacturer's specifications to enhance soil stabilization.

4.4.2 Seed Application

All disturbed areas should be seeded immediately following the final grading of the topsoil to the approximate original contour, weather and season permitting as discussed below. The seedbed should be prepared to a depth of three to four inches where possible to provide a firm seedbed. If hydroseeding or broadcast seeding is employed, the seedbed should be scarified to ensure good seed-soil contact. After completion of seedbed preparation, the seed mixtures presented in Tables B-2 through B-5, or a similar mix, as directed by the AO, should be applied according to the pure live seed (PLS) rates and drilling depths specified, to areas along the road and pipeline ROW, staging areas, and unused areas of drill sites that have been retopsoiled.

Seed should be used within 12 months of viability testing. Legume species purchased commercially must have been properly inoculated with nitrogen-fixing bacteria. Seed should be planted in the fall (after September 31) or no later than late fall (mid-November) prior to snow accumulation to avoid seed germination and breaking of dormancy and to prevent seedling frost damage; or in early Spring (prior to May 15); or as directed by the AO. Seed should not be applied when soils are frozen or excessively wet. Seed should preferably be planted with drill-type of equipment such as a rangeland drill or brillion seeder where and when possible as directed by the BLM. Where the microtopography of the disturbed areas does not allow drill-type equipment, seed should be broadcast applied at twice the application rate of drilled seed. A spike-toothed harrow or similar equipment should be used where ripping has been insufficient to provide cover for the broadcast seed. Some areas may require the planting of containerized seedlings to speed up successful reclamation particularly in areas of sensitive soils as described in Section 3.5 of the DEIS. Also, some seed is more effectively established by broadcast seeding as apposed to drill seeding such as Wyoming big sagebrush.

Any soil disturbance that occurs outside the recommended permanent seeding season, or any bare soil left unstabilized by vegetation, should be treated as a winter-construction problem and mulching should be considered, or the site stabilized and/or other actions taken as otherwise directed by the AO.

The seed mixtures presented in Tables B-2 through B-10, or similar mixtures as specified by the AO, should be applied according to specific areas identified to be homogeneous in terms of overall ecosystem similarities such as precipitation zones, elevational zones, dominant species herbaceous cover, soil types, and inherent limitations in reclamation success potential. Various vegetation cover types in the Moxa project area are described in Chapter 3 of the EIS and in the Vegetation Resources Technical Report (ECOTONE 1995b).

These seed mixes were developed based on the following criteria: 1) site-specific conditions of the analysis area; 2) species/cultivar adaptation to site conditions; 3) usefulness of species in rapid site stabilization; 4) species success in revegetation efforts; 5) current seed costs and availability; and 6) compliance with Executive Order 11987. Only native species are included in these seed mixes in compliance with Executive Order 11987 and the Rock Springs BLM reclamation policy. Certain introduced cultivars have been developed that have utility in site stabilization and revegetation. These species should only be considered if a revegetation or reclamation failure has occurred. The Operators should coordinate with the BLM AO in regard to approval of the use of introduced species in the reclamation effort. Final seed mixes applied in the revegetation effort should be designed in coordination with the BLM during the APD approval process.

Final determination of the appropriate seed mixture should be developed on a site-specific basis at the time of field review of the facility. Seeding rates may be varied to enhance the probability for maintaining the natural balance of species. Watershed protection must be emphasized when reclaiming disturbed areas. The composition of rare and native species, if encountered at a disturbed site, should be taken into consideration at the time of seeding; however, appropriate measures must be taken to ensure that an adequate protection of the soil surface is obtained. Areas not exhibiting successful revegetation (as

Table B-2. Seed Mixture[1] #1 - Mountain Shrub and Juniper Woodland Cover Types.

Species	Cultivar or Variety	Seed Application Drilled Rate (pls[2] lbs/ac)	Planting Depth (if drilled) (inches)
Grasses			
Western wheatgrass (*Agropyron smithii*)	Rosanna	2.0	0.5
Bluebunch wheatgrass (*Agropyron spicatum*)	Secar	3.0	0.5
Great Basin Wildrye (*Elymus cinereus*)	Trailhead	2.0	0.5
Indian ricegrass (*Oryzopsis hymenoides*)	Nezpar	3.0	0.5
Needle-and-Thread (*Stipa comata*)	-	1.0	0.5
Sandberg bluegrass (*Poa sandbergii*)	-	1.0	0.5
Forbs			
Gooseberryleaf globemallow (*Sphaeralcea grossulariaefolia*)	-	1.0	0.5
White yarrow (*Achillea millefolium*)	-	1.0	0.25
Silky lupine (*Lupinus sericeus*)	-	1.0	0.5
Northern sweetvetch (*Hedysarum boreale*)	-	0.5	0.5
Shrubs			
Wyoming big sagebrush (*Artemisia tridentata*)	-	0.5	0.25
Antelope bitterbrush (*Purshia tridentata*)	-	1.0	0.5
Winterfat (*Ceratoides lanata*)	-	1.0	0.5
TOTAL		**19.5**	

1 - Seed mix based on adaptation to the site conditions of the project, usefulness of species for rapid site stabilization, species success in revegetation efforts, and current seed availability and cost.

2 - PLS = pure live seed.

Table B-3. Seed Mixture[1] #2 - Mixed Desert Shrub Cover Type.

Species	Cultivar or Variety	Seed Application Drilled Rate (pls[2] lbs/ac)	Planting Depth (if drilled) (inches)
Grasses			
Western wheatgrass (*Agropyron smithii*)	Rosanna	2.0	0.5
Bluebunch wheatgrass (*Agropyron spicatum*)	Secar	3.0	0.5
Great Basin Wildrye (*Elymus cinereus*)	Trailhead	2.0	0.5
Indian ricegrass (*Oryzopsis hymenoides*)	Nezpar	3.0	0.5
Needle-and-Thread (*Stipa comata*)	-	1.0	0.5
Sandberg bluegrass (*Poa sandbergii*)	-	1.0	0.5
Forbs			
Gooseberryleaf globemallow (*Sphaeralcea grossulariaefolia*)	-	1.0	0.5
White yarrow (*Achillea millefolium*)	-	1.0	0.25
Northern sweetvetch (*Hedysarum boreale*)	-	2.0	0.5
Shrubs			
Wyoming big sagebrush (*Artemisia tridentata*)	-	0.5	0.25
Rubber rabbitbrush (*Chrysothamnus nauseosus*)	-	1.0	0.25
Winterfat (*Ceratoides lanata*)	-	1.0	0.5
Shadscale (*Atriplex confertifolia*)		2.0	0.5
TOTAL		**20.5**	

1 - Seed mix based on adaptation to the site conditions of the project, usefulness of species for rapid site stabilization, species success in revegetation efforts, and current seed availability and cost.

2 - PLS = pure live seed.

Table B-4. Seed Mixture[1] #3 - Vegetated Sand Dune Vegetation Cover Type.

Species	Cultivar or Variety	Seed Application Drilled Rate (pls[2] lbs/ac)	Planting Depth (if drilled) (inches)
Grasses			
Prairie sandreed (*Calamovilfa longifolia*)	Goshen	3.0	0.5
Bluebunch wheatgrass (*Agropyron spicatum*)	Secar	2.0	0.5
Sand dropseed (*Sporobolus cryptandrus*)	-	1.0	0.25
Indian ricegrass (*Oryzopsis hymenoides*)	Nezpar	3.0	0.5
Needle-and-Thread (*Stipa comata*)	-	0.5	0.5
Forbs			
Gooseberryleaf globemallow (*Sphaeralcea grossulariaefolia*)	-	1.0	0.5
Desert Indian paintbrush (*Castilleja chromosa*)	-	1.0	0.25
Northern sweetvetch (*Hedysarum boreale*)	-	1.0	0.5
Shrubs			
Wyoming big sagebrush (*Artemisia tridentata*)	-	0.5	0.25
Rubber rabbitbrush (*Chrysothamnus nauseosus*)	-	1.0	0.25
Spiny hopsage (*Grayia spinosa*)	-	1.0	0.5
Douglas rabbitbrush (*Chrysothamnus vicidiflorus*)	-	1.0	0.5
TOTAL		17.5	

1 - Seed mix based on adaptation to the site conditions of the project, usefulness of species for rapid site stabilization, species success in revegetation efforts, and current seed availability and cost.

2 - PLS = pure live seed.

Table B-5. Seed Mixture[1] #4 - Alkali Scrub Cover Type.

Species	Cultivar or Variety	Seed Application Drilled Rate (pls[2] lbs/ac)	Planting Depth (if drilled) (inches)
Grasses			
Sandberg bluegrass (*Poa sandbergii*)	-	2.0	0.5
Western wheatgrass (*Agropyron smithii*)	Rosanna	2.0	0.5
Alkaligrass (*Puccinellia distans*)	Fults	3.0	0.5
Alkali sacaton (*Sporobolus airoides*)	Salado	3.0	0.5
Forbs			
Gooseberryleaf globemallow (*Sphaeralcea grossulariaefolia*)	-	1.0	0.5
Northern sweetvetch (*Hedysarum boreale*)	-	2.0	0.5
Shrubs			
Spiny hopsage (*Grayia spinosa*)	-	1.0	0.5
Winterfat (*Ceratoides lanata*)	-	1.0	0.5
Gardner saltbush (*Atriplex gardneri*)	-	1.0	0.5
Black greasewood (*Sarcobatus vermiculatus*)	-	1.0	0.5
TOTAL		**17.0**	

1 - Seed mix based on adaptation to the site conditions of the project, usefulness of species for rapid site stabilization, species success in revegetation efforts, and current seed availability and cost.

2 - PLS = pure live seed.

Table B-6. Seed Mixture[1] #5 - Badlands Cover Type.

Species	Cultivar or Variety	Seed Application Drilled Rate (pls[2] lbs/ac)	Planting Depth (if drilled) (inches)
Grasses			
Sheep fescue (*Festuca ovina*)	Covar	3.0	0.5
Bottlebrush squirreltail (*Sitanion hystrix*)	-	3.0	0.5
Alkali sacaton (*Sporobolus airoides*)	Salado	3.0	0.5
Forbs			
Gooseberryleaf globemallow (*Sphaeralcea grossulariaefolia*)	-	1.0	0.5
Northern sweetvetch (*Hedysarum boreale*)	-	2.0	0.5
Shrubs			
Spiny hopsage (*Grayia spinosa*)	-	1.0	0.5
Winterfat (*Ceratoides lanata*)	-	1.0	0.5
Gardner saltbush (*Atriplex gardneri*)	-	1.0	0.5
TOTAL		**15.0**	

1 - Seed mix based on adaptation to the site conditions of the project, usefulness of species for rapid site stabilization, species success in revegetation efforts, and current seed availability and cost.

2 - PLS = pure live seed.

Table B-7. Seed Mixture[1] #6 - Wet Meadow Cover Type.

Species	Cultivar or Variety	Seed Application Drilled Rate (pls[2] lbs/ac)	Planting Depth (if drilled) (inches)
Grasses			
Nebraska sedge (*Carex nebrascensis*)	-	2.0	0.5
Redtop (*Agrostis stolonifera*)	-	2.0	0.5
Bluejoint reedgrass (*Calamagrostis canadensis*)	Sourdough	2.0	0.25
Tufted hairgrass (*Deschampsia cespitosa*)	-	4.0	0.25
Forbs			
Northern sweetvetch (*Hedysarum boreale*)	-	2.0	0.5
Blue-leaf aster (*Aster glaucodes*)	-	1.0	0.5
Golden banner (*Thermopsis montanus*)	-	2.0	0.5
TOTAL		**15.0**	

1 - Seed mix based on adaptation to the site conditions of the project, usefulness of species for rapid site stabilization, species success in revegetation efforts, and current seed availability and cost.

2 - PLS = pure live seed.

Table B-8. Seed Mixture[1] #7 - Riparian Forest and Riparian Shrub Cover Types.

Species	Cultivar or Variety	Seed Application Drilled Rate (pls[2] lbs/ac)	Planting Depth (if drilled) (inches)
Grasses			
Nebraska sedge (*Carex nebrascensis*)	-	2.0	0.5
Redtop (*Agrostis stolonifera*)	-	2.0	0.5
Bluejoint reedgrass (*Calamagrostis canadensis*)	Sourdough	2.0	0.25
Tufted hairgrass (*Deschampsia cespitosa*)	-	4.0	0.25
Forbs			
Northern sweetvetch (*Hedysarum boreale*)	-	2.0	0.5
Blue-leaf aster (*Aster glaucodes*)	-	1.0	0.5
Golden banner (*Thermopsis montanus*)	-	2.0	0.5
Shrubs			
Golden currant (*Ribes aureum*)	-	1.0	0.5
Red osier dogwood (*Cornus stolonifera*)	-	1.0	0.5
Silver buffaloberry (*Shepherdia argentea*)	-	1.0	0.5
Woods rose (*Rosa woodsii*)	-	1.0	0.5
TOTAL		**19.0**	

1 - Seed mix based on adaptation to the site conditions of the project, usefulness of species for rapid site stabilization, species success in revegetation efforts, and current seed availability and cost.

2 - PLS = pure live seed.

Table B-9. Planting Recommendations for Riparian Forest and Riparian Scrub Cover Types.]

Scientific Name	Common Name	Size
Alnus incana	Mountain alder	• 1-2 gal.
Betula occidentalis	Water birch	• 1 gal.
Populus angustifolia	Narrowleaf cottonwood	• 1-2 gal. or pole planting
Salix exigua	Sandbar willow	• tubepak, 1 gal., or sprig planting

Table B-10. Seed Mixture[1] #8 - Marsh Cover Type.

SPECIES	CULTIVAR OR VARIETY	SEED APPLICATION BROADCAST RATE (PLS[2] lbs/ac)	PLANTING DEPTH (inches)
GRASSES:			
Bluejoint reedgrass (*Calamagrostis canadensis*)	-	3.0	0.5
American sloughgrass (*Beckmannia syzigachne*)	Egan	4.0	0.25
GRAMINOIDS:			
Beaked sedge (*Carex rostrata*)	-	2.0	0.5
Alkali bulrush (*Scirpus maritima*)	-	2.0	0.5
Cattail (*Typha latifolia*)	-	0.5	0.25
TOTAL		11.5	

1 - Seed mix based on adaptation to the site conditions of the project, usefulness of species for rapid site stabilization, species success in revegetation efforts, current seed availability and cost, and specific project objectives.

2 - PLS = pure live seed.

determined by the AO or Environmental Inspector) should be reseeded and/or improved with soil amendments deemed necessary by the AO until an adequate cover of vegetation is established.

State, private, and agricultural lands should be seeded according to the landowner's request. Should the landowner not specify a recommended seed mixture, the AO should determine the appropriate seed mixture to apply.

4.4.3 Mulching

In sensitive sites where significant erosion (e.g., large areas of disturbance or areas with high erosion rates) is most likely to occur, the seeded access road/pipeline ROW, staging areas, and the portion of the drill pads not needed for production purposes should be mulched following seeding to protect the soil from wind and water erosion, raindrop impact, surface runoff, and noxious weed invasion, and to hold the seed in place. The exposed surface of disturbed areas, including topsoil stockpiles, may be protected by placing crimped straw mulch, hydromulch, biodegradable plastic netting and matting, or biodegradable erosion control blankets.

All sensitive disturbed areas should be mulched immediately following seeding with 1.5 to 2.0 tons/acre of a weed-free straw mulch. Mulching materials should be reasonably free of noxious and undesirable plant species as defined by state or county lists. Hay mulch may be used, but it should be applied only if cost-competitive and if crimped into the soil. Straw mulch is more desirable than hay mulch because it is generally less palatable to feral horses, wildlife, and livestock. Additionally, there tends to be a higher risk of introducing undesirable species and noxious weeds with a hay mulch such as smooth brome, timothy, orchardgrass and other minor species. The lessee should maintain all disturbances relatively weed-free for the life of the project through implementation of a noxious weed monitoring and eradication program.

Wherever utilized, mulch should be spread uniformly so that at least 75 percent of the soil surface is covered. If a mulch blower is used, the straw strands should not be shredded less than eight inches in length to allow effective anchoring. On slopes less than 30 percent, straw mulch should be applied by a mechanical mulch blower at a rate of 2.0 tons/acre after seeding. The mulch should be crimped into the soil surface using a serrated disc crimper or similar implement as directed by the AO. Where broadcast straw mulch is applied on windswept slopes, a biodegradable plastic netting should be staked firmly to the soil surface over the mulch following the manufacturer's specifications. On slopes in excess of 40 percent or on slopes exceeding the operating capabilities of machinery, hydromulch or biodegradable erosion control blankets with seed incorporated into the netting should be applied and staked firmly to the soil surface.

Where utilized, hydromulch and tackifier should be applied at a rate of 1,500 lbs/acre or as otherwise approved by the AO. In general, erosion control and soil stabilization are directly related to the amount of mulch applied. Under certain conditions where degradation processes are slow (e.g., in extremely hot or cold dry climates), a trade-off between the degree of effectiveness of mulch and long-term degradation should be considered. In extremely dry areas where mulch degradation may be slow, mulching rates should be reduced to 1.0 to 1.5 tons/acre or as specified by the AO. Special measures may need to be implemented in areas with sandy soils.

On steeper slopes with highly erodible, shallow, rocky soils and/or on windswept areas with loose, unconsolidated materials, the above recommended measures may not be sufficient to reduce erosion to non-significant levels. The following measure should be considered by the operator and the BLM to stabilize such sites: incorporating a custom blend of seed into erosion control blankets. This method has proven cost-effective in many cases, with 98 percent of the cost being the blanket itself. The additional cost of incorporating seed into the blanket will average $1.00 to $1.50 per blanket, depending upon current seed costs. In most cases, this additional cost should offset the repeated efforts of broadcast seeding, manual raking of seeds into the soil, and mobilizing a labor force to remediate unsuccessful revegetation. The AO should determine the final measure(s) to be implemented in such areas.

4.4.4 Livestock Control

Livestock grazing should be monitored along all areas of drill sites and access road and pipeline ROW. Should grazing negatively impact revegetation success, measures should be taken to immediately remove livestock from the newly reclaimed areas. Such measures could include herding, placement of mineral blocks, provision of water sources, and fencing. It would be cost infeasible to fence linear facilities (e.g., pipelines and roads). However, drill sites could be fenced. Depending upon site-specific evaluations, it may be necessary to temporarily fence off certain riparian areas and wetlands to prevent excessive livestock grazing and trampling to enhance drainage channel bank stabilization and overall revegetation success. Existing livestock control structures such as fences and cattleguards should be maintained in functional condition during all phases of the project. Where road access requires the disruption of an existing fence, a cattleguard should be installed at the juncture.

4.4.5 Off-Road Vehicle Control

Off-road vehicle control measures should be installed and maintained as specified by the AO and landowners following the completion of seeding. Examples of measures include a deep trench; a locking, heavy steel gate with fencing extending a reasonable distance to prevent bypassing the gate, with appropriate signs posted; a slash barrier; a pipe barrier; placement of large boulders; or signs posted at all points of access at intervals not to exceed 2,000 feet indicating "This Area Seeded for Wildlife Benefits and Erosion Control." Operators should monitor the use of pipeline alignments for adverse use and if degradation or damage of the revegetation effort is identified, appropriate remediation should be applied in consultation with the BLM.

4.4.6 Fugitive Dust Control

Should fugitive dust generated during construction of the drill sites, access road/pipeline ROWs, or staging areas become a problem, dust abatement measures should be implemented. Such procedures should be determined by the AO and could include applying water or water with additives (e.g., magnesium chloride) to the construction area at regular intervals, placement of gravel on traveled surfaces, placement of mulch and/or matting, or as directed by the AO.

4.5 Monitoring and Maintenance

4.5.1 General

Successful reclamation and revegetation cannot always be assured. Performance monitoring is required to evaluate the temporal condition of the effort, determine the prognosis for success, and determine if remediation is required. A designated BLM official or responsible representative of the Operators should annually inspect and review the condition of drill sites, access road/pipeline ROWs, and any other disturbed areas associated with the project. This official and/or representative should assess the success of and prognosis for success of runoff and erosion control and revegetation efforts, evaluate fugitive dust control needs, and recommend remediation measures, if necessary. In addition, monitoring should take place following each major runoff event. Photographs should be taken at drill sites and along access roads at specific areas to document the progress of the reclamation program at established photomonitoring points. The frequency and intensity of monitoring should be coordinated with the BLM.

The following specific items should be monitored during inspections:

- revegetation success;
- sheet and rill erosion, gullies, slumping, and subsidence;
- soundness and effectiveness of erosion control measures;
- sediment filtering devices along all active ephemeral and intermittent drainage channels;
- water quality and quantity;
- noxious weed invasion;
- degree of rodent damage on seed and seedlings;
- locations of unauthorized off-highway vehicle (OHV) access;
- soundness and effectiveness of OHV control structures;
- evidence of livestock or wildlife grazing; and
- overgrazing/trampling of riparian and wetland areas.

4.5.2 Reclamation Success Monitoring

Reclamation success should be based upon the objectives specified in this appendix; therefore, monitoring should be tied to these objectives. The actual monitoring procedures for quantitative and qualitative evaluations of reclamation success should be implemented as specified by the BLM or other authorizing agencies. The attachment to this appendix presents monitoring guidelines generally accepted by the BLM.

Reclamation success should be monitored both in the short term (temporary reclamation) and in the long term (final reclamation). Monitoring of temporary reclamation measures should include visual observations of soil stability, condition, and effectiveness of mulching and runoff and erosion control measures and a quantitative and qualitative evaluation of revegetation success, where appropriate. Long-term reclamation monitoring should include visual observations of soil stability, condition of the effectiveness of mulching and runoff and erosion control measures, and a quantitative and qualitative evaluation of revegetation success.

Revegetation success should be determined through monitoring and evaluation of percent ground cover to include a measure of vegetal cover (by species), litter/mulch, rock/gravel, and bare ground. Ground cover should be documented at each 1-foot interval along a 100-foot line intercept transect. Seedling density and relative abundance should be determined by selection of plots at the 20-, 40-, 60-, and 80-foot marks on the transect. Grazing impacts should be assessed as an ocular estimate of the percent utilization along the transect.

Soil stability should be measured using an erosion condition class/soil surface factor rating method to numerically rate soil movement, surface litter, surface rock, pedestalling, flow patterns, and rill-gully formation. Information obtained through this rating system represents an expression of current erosion activity and can be used to reflect revegetation success as a function of soil stability.

The access road boundaries, pipelines, and unused portions of the drill sites should be monitored until released by the AO upon attainment of 80 percent of predisturbance vegetative cover within five years of seeding. This standard should include 90 percent of the vegetative cover being comprised of desirable species and the erosion condition of the reclaimed area being equal to or in better condition than predisturbance conditions as prescribed under the Performance Standard section of this appendix.

4.5.3 Wetland and Drainage Channel Crossings

Wetland areas and natural drainage channel crossings should be monitored for a minimum of three years for noxious weed invasion and establishment of undesirable species. Noxious weeds should not be allowed to establish at any time. If found in a reclaimed wetland or drainage channel crossing, the noxious weeds should be removed. Undesirable species should not be allowed to establish. At the third year of monitoring, undesirable species should comprise no more than 15 percent of the total vegetation cover. The lessee should maintain wetland areas and drainage channel crossings according to this standard throughout the development of a noxious weed and undesirable species monitoring and eradication program.

4.5.4 Photomonitoring

Permanent photomonitoring points should be established at appropriate vantage locations that provide adequate visual access to drill sites, along pipeline and access road rights-of-way, and to ancillary facilities. Each photomonitoring point should be permanently marked with re-bar and identified on a topographic map of the area. The location of each point should be described in detail to assist in relocation from year to year. Photos should be taken at each photomonitoring point prior to initiation of construction. Photos, framing the same scene as previously taken, should be taken each formal visit until reclamation standards have been met. These photographs should be included in the periodic reports submitted to the BLM and other interested agencies.

5.0 REFERENCES CITED

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ATTACHMENT TO APPENDIX B

DRAFT

Rock Springs BLM District - Reclamation Performance Monitoring Guidelines

Objectives

The general purpose of this plan is to initiate a systematic, documented approach to monitoring existing and future reclamation of surface disturbance. This includes evaluation of methods to assist in making future land management decisions. More specific objectives include the following:

1. To outline agency and company responsibilities in regard to implementation of monitoring.
2. To provide guidelines for documenting site-specific information and monitoring procedures, methods and objectives.
3. To outline methods for monitoring progress and evaluating success of reclamation efforts.
4. To increase probability of the reclamation success on future projects.

Responsibility

Federal agency decisions generally establish the requirement for a formal monitoring program to evaluate the progress of revegetation and reclamation. This, along with soil erosion monitoring (through review of reclamation efforts and mass movement), is the responsibility of both agencies and companies involved with disturbance. This is to be accomplished through a joint, coordinated monitoring effort.

The following is a proposed outline of agency/company responsibility regarding implementation of the Revegetation, Reclamation and Erosion Monitoring Plan.

1. As part of the Erosion, Revegetation and Restoration Plan (ERRP), BLM and/or industry will submit an "initial" monitoring plan covering the extent of disturbance. This plan constitutes the Implementation Phase of monitoring and will follow the guidelines presented under "FORM I" of this report. Monitoring locations, timeframes and methodology will be agreed upon before acceptance of the Surface Use Plan (ERRP - pt. 10) by the agency. The monitoring will be installed by a designated "qualified" representative of the company (in coordination with the appropriate agency) immediately following initial rehabilitation work. This monitoring will be re-examined by the above representative at the end of the first growing season, with results documented in a report (see "FORM II") to the appropriate agency. Problem areas identified in this report will receive follow-up rehabilitation/erosion control measures.

2. During the second growing season, the designated agency personnel will revisit these established monitoring sites. Original methodology will be repeated and status of reclamation efforts assessed using the guidelines established in the FORM II of this report (Establishment Phase). Results will be documented in a project file (computer disk) and a report will be prepared. The monitoring results will be provided to each company or Operator, to show progress and call attention to additional stabilization/reclamation needs. Additional monitoring sites will be established by agency personnel (in coordination with the company) for "long term" monitoring on significant problem areas not covered by initial efforts.

3. Follow-up monitoring using the established sites and methodology will be accomplished by agency personnel annually, until reclamation goals are attained (see Criteria for Success). When this occurs, the monitoring site will be abandoned, however reference points will remain to allow potential future evaluation. Abandonment is expected on most sites within approximately 3 years. This will allow personnel to concentrate on monitoring installation and evaluation on "long term" problem sites. Companies will be advised to reclamation status through joint review of monitoring sites. Annual reports will continue, as will direction for additional remedial reclamation efforts if necessary.

4. The aforementioned proposal, applies to surface disturbances occurring after the finalization of the decision document. For disturbances existing before this time, the appropriate agency is responsible for initiation and follow-up monitoring, utilizing guidelines proposed in this report.

5. The last phase involves the final review and report on status. Generally, reclamation success in the decision document will be based on specific site potential. Revegetation objectives and success criteria (FORM I) will be tailored to site potential and agreed upon by both company and agencies. When the site has reached long term stabilization and the composition of desired forage is consistent with the above objectives and criteria, the monitoring site will be abandoned. At this point, data will be compiled (by the agency involved) in an effort to provide future direction for successful reclamation. Suggested successful reclamation methods will be provided in the annual report.

Monitoring Guidelines

The following form records are proposed as guidelines for covering the collection of site specific information, identification of revegetation objectives, documentation of treatments and a record for evaluation.

FORM I (*Reclamation and Erosion Monitoring; Background Data*) is the initial step in the monitoring process. The monitoring plan contained in the ERRP should cover the parameters outlined on this form, and the representative who will collect this data. It is suggested this background be collected immediately following initial reclamation work. A report containing this information will be prepared, prior to the annual review. Data collection (except for reference plot) will be accomplished by use of point sampling transects conducted within the right-of-way boundaries. These transects will be established with permanent stakes on the locations described in the ERRP.

FORM II (*Revegetation Evaluation*) is considered the annual monitoring, to be conducted by the company (for the first growing season) and agencies (annually until monitoring abandonment). It is suggested to take place during the seed ripe stage of plant development. A evaluation report containing this information will be prepared prior to the annual review.

FORM I
Revegetation and Erosion Monitoring: Background Data

A. Revegetation Project Name: ____________________

Company: ____________________ Telephone No: (   ) ____________

Data collected by: ____________________ (Company/Agency Representative)

Monitoring Site Number: ____________________

B. Legal Location	C. Slope % ______	D. Key Species in Reference Vegetation
Twp. ______	Aspect ________	____________________ - ______ %
Rng. ______	Elevation ______	____________________ - ______ %
Sec. ______	(include construction	____________________ - ______ %
Sub. ______	map with transect	____________________ - ______ %
	site marked)	____________________ - ______ %
		____________________ - ______ %

E. Soil:	Texture	- Rock Content		Texture	- Rock Content
0-6"	________	- ______ %	12-18"	________	- ______ %
6-12"	________	- ______ %	18-24"	________	- ______ %

F. Disturbance Description: Date ____________________

____

____

G. Revegetation Objective(s): ____________________

____

____

H. Criteria for Determining Success: ____________________

____

____

I. Reclamation Treatment Record - Date/season applied: ____________________

1. Topsoiling: ____________________

____

2. Erosion Control (type and method of installation): ____________________

____

____

FORM I, Continued

3. Soil Amendments (type, amount, and method of application): ____________________
____
____

4. Seed Mix (lbs pure live seed/acre by species): ____________________
____
____

5. Mulch (type and method of application): ____________________
____
____

6. Mechanical treatments (type and rationale): ____________________
____
____

7. Remarks: ____________________
____
____

J. Attach a 35 mm photograph of the monitoring transect and reference plot (if applicable) with dates. Photograph sites should be clearly marked on a reference map.

FORM II

Revegetation and Erosion Monitoring Evaluation

A. Revegetation Project Name: ____________________

Company: ____________________ Telephone No: (   ) ____________

Data collected by: ____________________ (Company/Agency Representative)

Monitoring Site Number: ____________________

B. Revegetation Evaluation:

1. Percent Cover

_______ % Plant
_______ % Litter
_______ % Rock
_______ % Bare Ground
_______ % Water
__100__ % Total

2. Dominant Species - Relative Percent

____________________ - _______
____________________ - _______
____________________ - _______
____________________ - _______
____________________ - _______
____________________ - _______
____________________ - _______
____________________ - _______
____________________ - _______
____________________ - _______

3. Seedling Density & Abundance

____________________: Average plants per linear ft. (drill row/transect)
____________________: Rating

4. Grazing Impact (Utilization)

____________________: Utilization
____________________: Rating

EROSION EVALUATION: Evaluate conditions 50 feet on either side of transect line. Assign a numerical rating for each category.

SURFACE LITTER	No movement, or if present, less than 2 percent of the litter has been translocated and redeposited against obstacles. 0 or 3	Between 2 and 10 percent of the litter has been translocated and redeposited against obstacles. 6	Between 10 and 25 percent of the litter has been translocated and redeposited against obstacles. 8	Between 25 and 50 percent of the litter has been translocated and redeposited against obstacles. 11	More than 50 percent of the litter has been translocated and redeposited against obstacles. 14
SURFACE ROCK MOVEMENT	No movement, or if present, less than 2 percent of the surface rock fragments have been translocated and/or redeposited against obstacles and show an even distribution on the landscape. 0 or 2	Between 2 and 10 percent of the surface rock fragments have been translocated/redeposited against obstacles and begun to show localized concentration. 5	Between 10 and 25 percent of the surface rock fragments have been translocated, redeposited against obstacles, and show localized concentration. 8	Between 25 and 50 percent of the surface rock fragments have been translocated, redeposited against obstacles, and show localized concentration. 11	More than 50 percent of the surface rock fragments have been translocated, deposited against obstacles, and show extreme localized concentration. 14
PEDESTALLING	Pedestals are mostly less than 0.1 in. (2.5 mm) high and/or less frequent that 2 pedestals per 100 ft². 0 or 3	Pedestals are mostly between 0.1 to 0.3 in. (2.5 to 8 mm) high and/or have a frequency of 2 to 5 pedestals per 100 ft². 6	Pedestals are mostly between 0.3 and 0.6 in. (8 to 15 mm) high and/or have a frequency of 5 to 7 pedestals per 100 yd². 9	Pedestals are mostly between 0.6 to 1 in. (15 to 25 mm) high and/or have a frequency of 1 to 10 pedestals per 100 ft². 12	Pedestals are mostly over 1 in. (25 mm) high and/or have a frequency of over 10 pedestals per 100 ft². 14
FLOW PATTERNS	None, or if present, less than 2 percent of the surface area shows evidence of recent translocation and deposition of soil and litter. 0 or 3	Between 2 and 10 percent of the surface area shows evidence of recent translocation and deposition of soil and litter. 6	Between 10 and 25 percent of the surface area shows evidence of recent translocation and deposition of soil and litter. 9	Between 25 and 50 percent of the surface area shows evidence of recent translocation and deposition of soil and litter. 12	Over 50 percent of the surface area shows evidence of recent translocation and deposition of soil and litter. 15
RILLS	Rills, if present, are mostly less than 0.5 in. (13 m) deep, and generally at infrequent intervals over 10 ft. 0 or 3	Rills are mostly 0.5 to 1 in. (13 to 25 mm) deep and generally at infrequent intervals over 10 ft. 6	Rills are mostly 1 to 1.5 in. (25 to 38 mm) deep and generally at 10-ft. intervals. 9	Rills are mostly 1.5 to 3 in. (38 to 76 mm) deep and at intervals of 5 to 10 ft. 12	Rills are mostly 3 to 6 inches (76 to 152) deep and at intervals of less than 5 ft. 14
GULLIES	No gullies, or if present, less than 2 percent of the channel bed and walls show active erosion (are not vegetated), gullies make up less than 2 percent of the total area. 0 or 3	Between 2 and 5 percent of the channel bed and walls show active erosion (are not vegetated), or gullies make up between 2 and 5 percent of the total area. 6	Between 5 and 10 percent of the channel bed and walls shows active erosion (are not vegetated), or gullies make up between 5 and 10 percent of the total area. 9	Between 10 to 50 percent of the channel bed and walls show active erosion (are not vegetated), or gullies make up between 10 to 50 percent of the total area. 12	Over 50 percent of the channel bed and walls show active erosion (are not vegetated) along their length, or gullies make up over 50 percent of the total area. 15
SOIL MOVEMENT	Depth of recent deposits around obstacles or in microterraces, and/or depth of truncated areas, is between 0 and 0.1 in. (0 to 2.5 mm). 0 or 3	Depth of recent deposits around obstacles or in microterraces, and/or depth of truncated areas, is between 0.1 and 0.2 in. (2.5 to 5 mm). 5	Depth of recent deposits around obstacles or in microterraces, and/or depth of truncated areas, is between 0.2 and 0.4 in. (5 to 10 mm). 8	Depth of recent deposits around obstacles or in microterraces, and/or depth of truncated areas, is between 0.4 and 0.8 in (10 to 20 cm). 11	Depth of recent deposits around obstacles or in microterraces, and/or depth of truncated areas, is over 0.8 in. (20 cm). 14

Erosion Condition Class: ____________ Soil Surface Factor: ____________

Methodology

Most items listed in the guidelines of FORM I and FORM II are self-explanatory. Those that require a detailed explanation of methods and ratings are listed herein.

FORM I

B. A 1:24,000 topographic map can be used to attain this information. This report should include the monitoring site transect location on the detailed construction drawings contained in the ERRP.

D. Reference vegetation serves as a standard of comparison to assess potential species for revegetation and success. The nature of comparisons with reference vegetation will depend on revegetation objectives. A reference plot location will be established on-the-ground and marked on the ERRP map. A 35 mm photo of the plot will accompany the report.

G. Soil stability, productivity restoration, and wildlife habitat enhancement are general examples of objectives.

H. Examples of Criteria for Success could include 60 percent groundcover for erosion control, soil surface factor of less than 45, specific diversity requirements for wildlife habitat, and specific production for livestock grazing. Criteria must be defined and measurable.

I. The reclamation treatment record should document what was actually done on-the-ground not necessarily what is outlined in ERRP. Short explanations on which topsoiling was completed, the erosion control methods used, fertilizes type and rate, seed mix by lbs/species, mulching methods, etc. should be described in this section. Any additional erosion control measures, should be included under remarks.

J. A photo record (35mm - 50mm lens) of the transect line from point A to point B, and any additional erosion control measures, should be included in the report. Each transect should have one photo showing the general view along the transect and one photo showing transect detail of the vegetation/soil surface. Photos should be properly labeled for date, transect, and direction of view.

FORM II

B.1. Percent cover is determined by examination of 100 points along a 100 foot transect. Documentation consists of recording the total number of "hits" for plant, litter, rock and bare ground. Each point noted, corresponds to every foot increment on the 100 foot tape. Data summarized from this transect is recorded here.

B.2. Dominant vegetative species along the transect are listed and their relative percent composition determined based on the number of "hits" for each species.

B.3. Seedling Density and Relative Abundance. Total number of plants is rated by selection of plots at the 20-, 40-, 60-, and 80-foot mark on the transect. At these points, perennial seedlings per linear foot or drill row (or in the case of broadcast seedling, per linear foot of transect) are recorded and averaged. Ratings are based on the evaluation system in the following table:

PLANTS/LINEAR FOOT	RATING
8+	Excellent
5-7	Good
3-4	Fair
0-2	Poor

B.4. The grazing impact is assessed as an ocular estimate of the percent utilization along the cover transect (at 10-foot intervals). Utilization of revegetation efforts is based on the removal of "seeded" grasses (current year's growth) by grazing. The amount of utilization is expressed in percent of above ground biomass which is grazed. The following table describes the ratings for various utilization ranges:

PERCENT UTILIZATION RANGE	RATING	GENERAL DESCRIPTION
1-40	Light	The revegetation may be topped, skimmed or grazed in patches, 60 to 80 percent of the number of current seed stalks remain intact. Most young plants are undamaged. Little or no use of non-palatable species.
44-60	Moderate	The revegetation appears entirely covered (grazed) as uniformly as natural features and facilities will allow. 15 to 25 percent of the number of current seed stalks remain intact. No more than 10 percent of the non-palatable species are utilized.
61-100	Heavy	The revegetation has the appearance of complete and repeated grazing use. Less than 10 percent of the current seed stalks are remaining. The remaining stubble of preferred grasses may be grazed to the soil surface.

C. The Erosion Condition Class/Soil Surface Factor method numerically rates soil movement, surface litter, surface rock, pedestalling, flow patterns and rill-gully formation and translates these physical factors into an evaluation of the vegetation and erosion stability of an area. Results are an expression of current erosion activity, and can be used to reflect revegetation success as a function of site stability.

Identify the numerical factor that most nearly describes the current erosion condition by circling the factors. Evaluate each erosional feature if water erosion is the **most prevalent** type of erosion. (Omit surface rock if not present.) If wind erosion is mosty prevalent, do not include the rill and gully features in the computation. The following table identifies the Erosion Condition Class based on the Soil Surface Factor:

EROSION CONDITION CLASS	SOIL SURFACE FACTOR (Range)
Stable	1-20
Slight	21-40
Moderate	41-60
Critical	61-80
Severe	81-100

APPENDIX C

HAZARDOUS SUBSTANCES MANAGEMENT PLAN

APPENDIX C

HAZARDOUS SUBSTANCES MANAGEMENT PLAN

C.0 INTRODUCTION

The Moxa Arch oil and gas operators (Operators) propose to explore and develop natural gas reserves in the Moxa Arch area of Lincoln, Sweetwater and Uinta Counties, Wyoming. The Bureau of Land Management (BLM) has prepared an Environmental Impact Statement (EIS) for the proposed project, and this Hazardous Substance Management Plan (HSMP), which is included as an appendix to the EIS, provides further specific information regarding the types and quantities of hazardous and extremely hazardous substances that are expected to be produced or used for the proposed project. Detailed descriptions of the proposed action and alternatives, the potential environmental consequences, and proposed mitigation and monitoring measures are provided in the EIS.

This HSMP is provided pursuant to BLM Instruction Memoranda Numbers WO-93-344 and WY-94-059, which require that all National Environmental Policy Act (NEPA) documents list and describe any hazardous and/or extremely hazardous substances that would be produced, used, stored, transported or disposed of as a result of a proposed project. Hazardous substances, as defined herein, are those substances listed in the Environmental Protection Agency's (EPA's) *Consolidated List of Chemicals Subject to Reporting Under Title III of the Superfund Amendments and Reauthorization Act (SARA) of 1986*, and extremely hazardous substances are those identified in the EPA's *List of Extremely Hazardous Substances* (40 Code of Federal Regulations [CFR] 355). The Operators have reviewed these EPA lists, as amended, and substances included on either of these two lists that could be present in any amount over the life of the proposed project are listed and/or discussed herein.

Some potentially hazardous substances that may be used in small, unquantifiable amounts have been excluded from this HSMP. These substances may include: wastes, as defined by the Solid Waste Disposal Act; wood products; manufactured items and articles which do not release or otherwise result in exposure to a hazardous substance under normal conditions of use (i.e., steel structures, automobiles, tires, etc.); food, drugs, tobacco products, and other miscellaneous substances (i.e., WD-40, gasket sealants, glues, etc.). No unauthorized use or disposal of these substances by project personnel would occur during project implementation, and all project personnel would be directed to properly dispose of these substances in an appropriate manner. Solid wastes generated at well locations would be collected in approved waste containers (e.g., trash baskets or dumpsters), and each well location would be provided with one or more such containers during drilling and completion operations. Solid wastes would be regularly removed from well locations and transported off the Moxa Arch project area to approved disposal facilities.

C.1 HAZARDOUS SUBSTANCES

A listing of all relevant known hazardous and extremely hazardous substances that may be used, produced, stored, or disposed of during project implementation is provided herein. Where possible, the quantities of these substances have been estimated on a per-well basis and their use, storage, and disposal methods described.

C.2 PRODUCTION PRODUCTS

The purpose of the proposed project is to extract natural gas and oil (condensates) from the Frontier and Dakota Formations and other formations underlying the Moxa Arch. Water would also be produced as a by-product of gas and oil extraction operations. Table C-1 lists and quantifies, where possible, the hazardous and extremely hazardous materials that may be found in these production products.

C.2.1 Natural Gas

Natural gas, primarily containing methane and ethane would be produced from approximately 1325 wells at rates averaging 1.5 million cubic feet per day (mmcfd) per well, declining to 200 to 800 thousand cubic feet per day (mcfd) after 5 years. No extremely hazardous substances are anticipated to be produced with the gas stream; however, the hazardous substance hexane (CAS Number 110-54-3) would be present in the gas stream at volumes ranging from approximately 7 to 8 mcfd per well (Table C-1). In addition, the gas would also likely contain small amounts of potentially hazardous polycyclic organic matter and polynuclear aromatic hydrocarbons. No other hazardous materials are known to occur within the natural gas stream.

The majority of gas produced from Moxa Arch wells would be transported from each location through newly constructed pipelines linking well locations to existing or newly constructed gas processing facilities. The natural gas would eventually be delivered to consumers for combustion. Small quantities of natural gas may be vented or flared at certain well locations during well testing operations. During testing, produced gas would be vented or flared into a flare pit pursuant to BLM/Wyoming Oil and Gas Conservation Commission (WOGCC) rules and regulations (Notice to Lessees [NTL]-4A). BLM and WOGCC approval would be obtained prior to flaring or venting operations. No natural gas storage is anticipated.

Industry standard pipeline equipment, materials, techniques, and procedures in conformance with all applicable regulatory requirements would be employed during construction, testing, operation, and maintenance of the project to ensure pipeline safety and efficiency. All necessary authorizing actions for natural gas pipelines would be addressed prior to installation.

These actions include:

- Lincoln, Sweetwater and Uinta County special use permits,
- BLM rights-of-way (ROWs) applications,
- Conformance with U.S. Department of Transportation (DOT) pipeline regulations (49 CFR191-192), and
- Wyoming Public Service Commission Certificates to act as common carrier for natural gas.

C.2.2 Condensates

Condensates would be produced with the gas stream at most of the proposed wells. Condensates primarily consist of long chain hydrocarbon liquids (e.g., octanes), but may also contain variable quantities of polycyclic organic matter and polynuclear aromatic hydrocarbons. No other hazardous or extremely hazardous substances are known to be present in the condensates. The volume of condensate produced

Table C-1. **Hazardous and Extremely Hazardous Materials Potentially Produced by the Moxa Arch Natural Gas Project, Lincoln, Sweetwater and Uinta Counties, Wyoming, 1995.**

Production Product	Hazardous Constituents[1]	Extremely Hazardous Constituents[2]	Approximate Quantity Produced per Well[3]
Natural Gas	--	None	1.5 mmcfd
	Hexane		7.6 mcfd
	PAHs[4]		
	POM[5]		
Condensates	--	None	504 gpd
	PAHs		
	POM		
Produced Water	--	None	210 gpd
	Lead		
	Cadmium		
	Chromium		
	Radium 226		
	Uranium		

1 - The hazardous constituents listed are, to the best of our present knowledge, those that are or may be present in the production products and are listed under the EPA's *Consolidated List of Chemicals Subject to Reporting Under Title III of the Superfund Amendments and Reauthorization Act (SARA) of 1986*, as amended.
2 - Extremely hazardous materials are those defined in 40 CFR 355.
3 - mmcfd = million cubic feet per day.
mcfd = thousand cubic feet per day.
gpd = gallons per day.
4 - PAHs = polynuclear aromatic hydrocarbons.
5 - POM = polycyclic organic matter.

from Moxa Arch wells is anticipated to be approximately 504 gallons per day (gpd) from most wells (Table C-1).

Condensates would be stored in tanks at well locations and centralized facilities, and all tanks would be fenced and bermed to contain at least 125% of the entire storage capacity of the largest tank. Condensates would be periodically removed from storage tanks and transported off Moxa Arch or collected in a stabilization system. All necessary authorizing actions for the production, storage, and transport of condensates, including the Oil Pollution Act of 1990 (storage of >1,000,000 gal) as necessary, would be addressed prior to the initiation of condensate production activities.

C.2.3 Produced Water

Produced water from Moxa Arch wells is anticipated to range in volume from 40 to 840 gpd, and would average approximately 210 gpd for most wells (Table C-1). Produced water quality from wells in Moxa

Arch is variable and would be monitored periodically. Based on WOGCC-required water quality analyses of produced water samples from several Moxa Arch wells, no hazardous or extremely hazardous substances are known to be present in the produced water.

Produced water would be stored in tanks at well locations and centralized facilities and would periodically be removed and transported by truck to an existing permitted disposal well facility or evaporation pond. Where applicable, National Pollutant Discharge Elimination System (NPDES) permits would be obtained from the WDEQ, and produced water that meets applicable standards would be discharged to the surface at appropriate locations. All necessary authorizing actions would be met prior to the disposal of produced water including:

- BLM approval of disposal methodologies,
- RCRA compliance as necessary,
- WDEQ Water Quality Division (WDEQ-WQD) and/or WOGCC approval of wastewater disposal,
- WOGCC and/or WDEQ-WQD evaporation pond permits, and
- Wyoming State Engineer's Office (SEO) dewatering permits (Form U.W. 5).

C.4 CONSTRUCTION, DRILLING, PRODUCTION, AND RECLAMATION

Known hazardous and extremely hazardous substances that may be used during construction, drilling, production, and reclamation operations for the proposed project are listed at the end of this appendix. Hazardous and extremely hazardous substances used during typical project implementation fall into the following categories:

- fuels,
- lubricants,
- coolant/antifreeze and heat transfer agents,
- drilling fluid additives,
- fracturing fluids,
- cement and additives, and
- miscellaneous materials.

These substances are described in detail below.

C.4.1 Fuels

Gasoline (CAS 8006-61-9), diesel fuel (CAS 68476-30-2), and natural gas are the fuels proposed for use on the project, and all contain substances deemed hazardous. Gasoline would be used to power vehicles providing transportation to and from Moxa Arch; diesel fuel would be used to power transport vehicles, drilling rigs, and construction equipment, and as a component of fracturing fluids (see Section C.4.5); and natural gas would be used to power pipeline compressor stations.

Gasoline. Gasoline would be used to power vehicles traveling to and from Moxa Arch. The hazardous substances present in gasoline include: benzene (CAS 71-43-2), toluene (CAS 108-88-3), ethylbenzene (CAS 100-41-4), p-xylene (CAS 106-42-3), m-xylene (CAS 108-38-3), o-xylene (CAS 95-47-6), methyl tert-butyl ether (CAS 1634-04-4), polynuclear aromatic hydrocarbons, and polycyclic organic matter.

Leaded gasoline contains tetraethyllead (CAS 78-00-2), which is listed as an extremely hazardous substance.

Gasoline would be purchased from regional vendors, and would primarily be stored and transported in vehicle gas tanks. Some additional gasoline storage may be provided in appropriately designed and labeled 1 to 5 gallon containers for supplemental use as vehicle fuel. Gasoline would be used exclusively as a fuel for transport vehicles, being burned in internal combustion engines. No large scale storage of gasoline is anticipated.

Diesel Fuel. Diesel fuel for vehicle use would be used, transported, and stored as described in the sub-section above under gasoline. Additional diesel fuel would be utilized to power drilling rigs, workover rigs, pumping equipment, and road maintenance and reclamation equipment. Diesel fuel would also be used as a minor fracturing fluid constituent (see Section C.4.5).

Diesel fuel consists mainly of hydrocarbons containing from 15 to 25 carbons, and potentially containing hazardous substances, including: benzene, toluene, ethylbenzene, p-xylene, m-xylene, o-xylene, methyl tert-butyl ether, naphthalene, polynuclear aromatic hydrocarbons, and polycyclic organic matter. No extremely hazardous substances are known to be present in diesel fuel.

During drilling operations, each well location would have an above-ground storage tank containing diesel. These tanks would be filled as needed by a qualified, licensed fuel supplier, and use, transport, and storage of diesel fuel would be conducted in accordance with all relevant state and/or federal rules, regulations, and guidelines.

Natural Gas. An unknown volume of natural gas would be burned to provide power for the natural gas compressor stations required for efficient pipeline function. The natural gas used to power compressor stations would be produced by the proposed project, and hazardous substances possibly contained in this natural gas are hexane, polynuclear aromatic hydrocarbons and polycyclic organic matter. Further detail on the transportation of natural gas as a result of the proposed project as well as relevant authorizing actions for natural gas transportation, are provided in Section C.2.1.

C.4.2 Lubricants

Various lubricants including motor oils, hydraulic oils, transmission oils, compressor lube oils, and greases, would be utilized for project-required vehicles, rigs, compressors, and other machinery. Some of these lubricants would likely contain polynuclear aromatic hydrocarbons and polycyclic organic matter, and some may additionally contain compounds of lead, cadmium, nickel, copper, manganese, barium, zinc, and/or lithium. No extremely hazardous substances are known to be present in the lubricants required for the proposed project.

The exact quantity of each lubricant used, stored, transported, and disposed of is unknown; however, all lubricants would be used, stored, transported, and disposed of following manufacturer's guidelines. No unauthorized disposal of lubricants (e.g., disposal of used motor oil) would occur in connection with the project.

C.4.3 Coolant/Antifreeze and Heat Transfer Agents

Ethylene glycol (CAS 107-21-1) and triethylene glycol (CAS 112-27-6) would be utilized as coolant/antifreeze and heat transfer agents in association with this project. Ethylene glycol would be used as an engine coolant/antifreeze in automobiles, construction equipment, gas dehydrators, and drilling and workover rigs. An unspecified volume of this substance would be stored and transported in engine radiators. In addition, both ethylene glycol and triethylene glycol would be used as heat transfer fluids during well completion and maintenance operations. While the exact total volume of ethylene glycol to be used, stored, transported, and disposed of for the proposed project is unknown, any disposal of ethylene glycol and/or triethylene glycol would be conducted in accordance with all relevant federal and state rules and regulations.

C.4.4 Drilling Fluids and Additives

Fresh water would be used for drilling the first 5,000 to 7,000 feet of each well, and water-based muds (drilling fluids) would be used for drilling deeper portions of each well. Drilling fluids consist of clays and other additives that are used in standard industry procedures. All drilling operations would be conducted in compliance with applicable BLM, WOGCC, and WDEQ rules and regulations.

All known hazardous substances that may be present in the proposed drilling fluids and additives are listed at the end of this appendix. No extremely hazardous substances are known to be present in any of the drilling fluids and additives.

Drilling fluid additives would be transported to well locations during drilling operations in appropriate sacks and containers in compliance with DOT regulations. Drilling fluids, cuttings, and water would be stored in reserve pits, and pits would be fenced to protect wildlife from exposure.

When the reserve pit is no longer required, its contents would be evaporated or solidified in place, and the pit backfilled, as approved by the BLM. All reserve pit solidification procedures using flyash or other BLM-approved materials would be approved by the WOGCC and/or WDEQ prior to implementation. If necessary under special, unanticipated circumstances, reserve pit contents would be removed and disposed of at an appropriate facility in accordance with all relevant state and federal regulations.

C.4.5 Fracturing Fluids

Hydraulic fracturing is expected to be performed at many Moxa Arch wells to augment gas flow rates. The hazardous substances present in fracturing fluid components are listed at the end of this appendix. No extremely hazardous substances are known to be present in any of the fracturing fluid additives.

Fracturing fluids and additives would be transported to well locations in bulk or in appropriately designed and labeled containers. All transportation of fracturing fluids and additives would be in adherence with DOT rules and regulations.

During fracturing, fluids are pumped under pressure down the well bore and out through perforations in the casing into the formation. The pressurized fluid enters the formation and induces hydraulic fractures. When the pressure is released at the surface, a portion of the fracturing fluids would be forced to the well bore and up into a tank or pit. The fracturing fluids would then be transferred to reserve pits and evaporated, or hauled away from the location and reused or disposed of at an authorized facility. Decisions regarding the appropriate disposal of fracturing fluids would be made by the BLM on a case-by-case basis.

C.4.6 Cement and Additives

Well completion and abandonment operations would entail cementing and plugging various segments of the well bore to protect freshwater aquifers and other down-hole resources. Materials potentially used for cementing operations include: cement, calcium hydroxide, calcium chloride, pozzlans, sodium bicarbonate, potassium chloride, and insulating oil. An unknown quantity of cement and additives, which may contain the hazardous material classes of fine mineral fibers, polycyclic organic matter, and polynuclear aromatic hydrocarbons, would be transported in bulk to each well site by a qualified cement supply company. Small quantities may be transported and stored on-site in 50 pound sacks. Wells would be cased and cemented as directed and approved by the BLM (for federal minerals) and WOGCC (for state and patented minerals). No extremely hazardous substances are known to be present in the cement and additives proposed for use on this project.

C.4.7 Miscellaneous Materials

Miscellaneous materials, potentially containing hazardous and/or extremely hazardous substances which may be used for the proposed project include methanol and corrosion inhibitors. These substances would be transported to the site by qualified service and supply companies and would be used and disposed of following manufacturer's guidelines.

An unknown quantity of methanol would be used to de-ice well bores and as a hydrate preventer during completion and natural gas transport operations. Methanol is a listed hazardous chemical and would be stored, transported, used, and disposed of in adherence with all applicable federal and state rules, regulations, and guidelines.

C.5 COMBUSTION EMISSIONS

Combustion emissions from gasoline and diesel engines, as well as flaring natural gas, will occur as a result of this project. The complete oxidation of hydrocarbon fuels yields only carbon dioxide and water as combustion products; however, complete combustion is seldom achieved. Unburned hydrocarbons, particulate matter (e.g., carbon, metallic ash), carbon monoxide, nitrogen oxides, and possibly sulfur oxides would be expected as direct exhaust contaminants. Secondary contaminants would likely include the formation of ozone from the photolysis of nitrogen oxides. A listing of the hazardous and extremely hazardous substances potentially present in combustion emissions is provided in Table C-2. Secondary contaminants would likely include the formation of ozone from the photolysis of nitrogen oxides. A listing of the hazardous and extremely hazardous substances potentially present in combustion emissions is provided in Table C-2.

Unburned hydrocarbons may contain potentially hazardous polynuclear aromatic hydrocarbons, and particulate matter may contain metal-based particulates from lead anti-knock compounds in the fuel, metallic lubricating oil additives, and engine wear particulates (Table C-3). Hazardous substances in the particulate matter may therefore include compounds of lead, cadmium, nickel, copper, manganese, barium, zinc, and/or lithium.

Nitrogen dioxide (CAS 10102-44-0), sulfur dioxide (CAS 7446-09-5), sulfur trioxide (CAS 7446-11-9), and ozone (CAS 10028-15-6) are probable combustion emissions, all classified as extremely hazardous substances. These substances would be either directly released in minor quantities from internal combustion engines, or would be formed through photolysis (i.e., ozone). No releases of these or other materials would occur in excess of those allowed for Prevention of Significant Deterioration Class II areas, WDEQ-Air Quality Division Implementation Plan, nor would releases occur that jeopardize National Ambient Air Quality Standards for Moxa Arch. Particulate matter emissions and larger unburned hydrocarbons would eventually settle out on the ground surface, whereas gaseous emissions would react with other air constituents as components of the nitrogen, sulfur, and carbon cycles.

C.6 MANAGEMENT POLICY AND PROCEDURE

The Moxa area operators and their contractors would ensure that all production, use, storage and disposal of hazardous and extremely hazardous substances as a result of the proposed project would be in strict accordance with all applicable existing, or hereafter promulgated federal, state, and local government rules, regulations, and guidelines. All project-related activities involving the production, use, storage and/or disposal of hazardous or extremely hazardous substances would be conducted in such a manner as to minimize potential environmental impacts.

The Moxa area operators would comply with emergency reporting requirements for releases of hazardous substances. Any release of hazardous or extremely hazardous substances in excess of the reportable quantity, as established in 40 CFR 117, would be reported as required by the *Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980*, as amended. The substances for which such notification must be given are the extremely hazardous substances listed under the *Emergency Planning and Community Right to Know* Section 302 and the hazardous substances designated under Section 102 of CERCLA, as amended. If a reportable quantity of a hazardous or extremely hazardous substance is released, prompt notice of the release would be given to the BLM's Authorized Officer and all other appropriate federal and state agencies. Additionally, notice of any spill or leakage (i.e., undesirable event), as defined in BLM NTL-3A, would be given by Moxa area operators to the Authorized Officer and other such federal and state officials as required by law.

The Moxa area operators have evaluated field operations in Moxa Arch and have prepared or would prepare and implement plans and/or policies to ensure environmental protection from hazardous and extremely hazardous substances. These plans/policies include, where applicable:

- Spill Prevention, Control and Countermeasures (SPCC) plans for each Moxa Arch field;
- oil/condensate spill response plans;
- inventories of hazardous chemical categories pursuant to Section 312 of the SARA, as amended; and
- emergency response plans.

Development operations in Moxa Arch would be in compliance with regulations promulgated under the Resource Conservation and Recovery Act (RCRA), Federal Water Pollution Control Act (Clean Water Act), Safe Drinking Water Act (SWDA), Toxic Substances Control Act (TSCA), Occupational Safety and Health Act (OSHA), and the Federal Clean Air Act (CAA). In addition, project operations would also

Table C-2. Hazardous and Extremely Hazardous Materials Potentially Present in Combustion Emissions of the Moxa Arch Natural Gas Project, Lincoln, Sweetwater and Uinta Counties, Wyoming, 1995.

Emission	Hazardous Constituents[1]	Extremely Hazardous Constituents[2]
Hydrocarbons	-- PAHs[3]	None
Particulate Matter	-- Lead Cadmium Nickel Copper Manganese Barium Zinc Lithium	None
Gases	-- Nitrogen dioxide Sulfur dioxide Sulfur trioxide Ozone	-- Nitrogen dioxide Sulfur dioxide Sulfur trioxide Ozone

1 - The hazardous constituents listed are, to the best of our present knowledge, those that are or may be present in the production products and are listed under the EPA's *Consolidated List of Chemicals Subject to Reporting Under Title III of the Superfund Amendments and Reauthorization Act (SARA) of 1986*, as amended.

2 - Extremely hazardous materials are those defined in 40 CFR 355.

3 - PAHs = polynuclear aromatic hydrocarbons.

comply with all attendant state rules and regulations relating to hazardous substance reporting, management and disposal. Table C-3 lists potential hazardous chemical categories for the oil and gas industry.

Table C-3. Generic List of Hazardous Chemical Categories for the Oil and Gas Exploration and Production Industry.

Hazardous Chemical Category (With Examples of Representative Chemicals)	Physical and Health Hazards	Approx. Quantity Onsite (BBLS, unless noted otherwise)
Acids Hydrochloric Acid (<30%)(CAS#7647-01-0)	Immediate (Acute)	10-50
Alkalinity and pH Control Materials Calcium hydroxide (CAS#1305-62-0) Potassium hydroxide (CAS#1310-58-3) Soda ash (CAS#497-19-8) Sodium bicarbonate (CAS#144-55-8) Sodium carbonate (CAS#497-19-8) Sodium hydroxide (CAS#1310-73-2)	Immediate (Acute)	500-1000 lbs.
Biocides Amines Glutaraldehyde (CAS#111-30-8) Isoporpanol (CAS#67-63-0) Thiozolin	Immediate (Acute), Fire	2-20
Acrolein (CAS#107-02-8)	Fire, Sudden release of pressure, Immediate(Acute)	1-2
Anhydrous Ammonia	Sudden release of pressure, Immediate(Acute)	1-2
Formaldehyde	Fire, Immediate (Acute), Delayed (Chronic)	2-20
Breakers Ammonium persulfate (CAS#7727-54-0) Benzoic acid (CAS#65-85-0) Enzyme Sodium acetate (CAS#127-09-3) Sodium persulfate (CAS#7772-27-1)	Immediate (Acute), Fire	0-500 lbs.
Buffers Sodium acetate (CAS#127-09-3) Sodium bicarbonate (CAS#144-55-8) Sodium carbonate (CAS#497-119-8) Sodium deacetate	Immediate (Acute)	500-1000
Calcium Compounds Calcium bromide (CAS#71626-99-8) Calcium hypochlorite (CAS#7778-54-3) Calcium oxide (CAS#1305-78-8) Gypsum (CAS#10101-41-4) Lime (CAS#1305-78-8)	Immediate (Acute)	1000-3000 lbs.
Cement (CAS#65997-15-1)	Immediate (Acute)	1000-1500 lbs.

Table C-3. Generic List of Hazardous Chemical Categories for the Oil and Gas Exploration and Production Industry.

Hazardous Chemical Category (With Examples of Representative Chemicals)	Physical and Health Hazards	Approx. Quantity Onsite (BBLS, unless noted otherwise)
Cement Additives - Accelerators Calcium chloride (CAS#10035-04-8) Gypsum (CAS#10101-41-4) Potassium chloride Sodium chloride (CAS#7647-14-5) Sodium metasilicate	Immediate (Acute)	5000-20,000 lbs.
Cement Additives - Fluid Loss Cellulose polymer Latex	Immediate (Acute)	50-1000 lbs.
Cement Additives - Miscellaneous Cellulose flakes (CAS#9004-34-6) Coated aluminum Gilsonite (CAS#12002-43-6) Lime (CAS#1305-78-8) Long chain alcohols	Immediate (Acute)	0-500 lbs.
Cement Additives - Retarders Cellulose polymer Lignosulfonates	Immediate (Acute)	0-1000 lbs.
Cement Additives - Weight Modification Barite (CAS#7727-43-7) Bentonite Diatomatious earth (CAS#68855-54-9) Fly ash Glass beads Hematite (CAS#1317-60-8) Ilmenite Pozzolans	Immediate (Acute)	500-20,000 lbs.
Corrosion Inhibitors 4-4' Methylene dianiline (CAS#101-77-9) Acetylenic alcohols Amine Formulations Ammonium bisulfite (CAS#10192-30-0) Basic zinc carbonate (CAS#3486-35-9) Gelatin Ironite sponge (CAS#1309-37-1) Sodium chromate (CAS#7775-11-3) Sodium dichromate (CAS#10588-01-9) Sodium polyacrylate Zinc lignosulfonate Zinc oxide (CAS#1314-13-2)	Immediate (Acute), Delayed (chronic), Fire	2-20

Table C-3. Generic List of Hazardous Chemical Categories for the Oil and Gas Exploration and Production Industry.

Hazardous Chemical Category (With Examples of Representative Chemicals)	Physical and Health Hazards	Approx. Quantity Onsite (BBLS, unless noted otherwise)
Crosslinkers Boron Compounds Organo-metallic complexes	Immediate (Acute), Fire	300-500 lbs.
Defoaming Agents Aluminum stearate Fatty acid salt formation Mixed alcohols Silicones	Immediate (Acute)	1-5
Deflocculants Acrylic polymer Calcium lignosulfonate Chrome-free lignosulfonate Chromium lignosulfonate Iron lignosulfonate Quebracho Sodium acid pyrophosphate (SAPP) Sodium hexametaphosphate (CAS#10124-56-8) Sodium phosphate (oilfos) Sodium tetraphosphate Stryene, maleaic anhydride co-polymer salt Sulfo-methylated tannin	Immediate (Acute)	500-1000 lbs.
Detergents/Foamers Amphoteric surfactant formulation Ethoxylated phenol Detergents	Immediate (Acute), Fire	2-20
Explosives Charged well jet perforating gun, Class C explosives Detonators, Class A explosives Explosive power device, Class B	Sudden release of pressure	0-100 lbs.

Table C-3. Generic List of Hazardous Chemical Categories for the Oil and Gas Exploration and Production Industry.

Hazardous Chemical Category (With Examples of Representative Chemicals)	Physical and Health Hazards	Approx. Quantity Onsite (BBLS, unless noted otherwise)
Filtration Control Agents Acrylamide AMPS copolymer Aniline formaldehyde copolymer hydrochlorite Causticized leonardite Sulfomethylated phenol formaldehyde Leonardite Partially hydrolyzed polyacrylamide Polyalkanolamine ester Polyamine acrylate Polyanionic cellulose Potassium lignite Preserved starch Sodium carboxymethyl cellulose (CAS#9004-32-4) Starch (CAS#9005-25-8) Vinylsulfonate copolymer	Immediate (Acute)	20-200
Friction Reducers Acrylamide methacrylate copolymers Sulfonates	Immediate (Acute)	2-20
Fuels Diesel (CAS#68476-34-6) Fuel oil Gasoline (CAS#8006-61-9) Kerosene (CAS#8008-20-6) Propane (CAS#74-98-6)	Immediate (Acute), Delayed (Chronic), Fire	200-400
Gelling Agents Cellulose and guar derivatives	Immediate (Acute)	1500-5000 lbs.
Gel Stabilizers Sulfites Thiosulfates	Immediate (Acute)	1-2
Heat Transfer Fluids Ethylene Glycol (CAS# 107-21-1) Freon	Immediate (Acute, Delayed (Chronic)	20-200
Herbicides	Immediate (Acute)	2-20
Hydraulic Fluids	Fire, Immediate (Acute)	2-20

Table C-3. Generic List of Hazardous Chemical Categories for the Oil and Gas Exploration and Production Industry.

Hazardous Chemical Category (With Examples of Representative Chemicals)	Physical and Health Hazards	Approx. Quantity Onsite (BBLS, unless noted otherwise)
Inert Gases Carbon Dioxide (CAS#124-38-9) Nitrogen (CAS#7727-37-9)	Immediate (Acute), Sudden release of pressure	0-400 tons
Lost Circulation Materials Cane fibers Cedar fibers Cellophane fibers Corn cob Cottonseed hulls Mica (CAS#12001-26-2) Nut shells Paper Rock wool Sawdust	Immediate (Acute)	0-1000 lbs.
Lubricants, Drilling Mud Additives Graphite (CAS#7782-42-5) Mineral oil formulations Organo-fatty acid salt Vegetable oil formulations Walnut Shells	Immediate (Acute)	2-20
Lubricants, Engine Motor oil Grease	Immediate (Acute)	2-20
Miscellaneous Drilling Additives Diatomaceous Earth (CAS#68855-54-9) Oxalic acid (CAS#144-62-7) Potassium acetate (CAS#127-08-2) Zinc bromide (CAS#7699-45-8)	Immediate (Acute), Delayed (Chronic)	100-500 lbs.
Odorants Mercaptans, aliphatic	Immediate (Acute)	0-1

Table C-3. **Generic List of Hazardous Chemical Categories for the Oil and Gas Exploration and Production Industry.**

Hazardous Chemical Category (With Examples of Representative Chemicals)	Physical and Health Hazards	Approx. Quantity Onsite (BBLS, unless noted otherwise)
Oil Based Mud Additives Amid polymer formulations Amine treated lignite Asphalt Diesel (CAS#68476-34-6) Gilsonite (CAS#12002-43-6) Mineral oil Organophilic clay Organophilic hectorite Petroleum distillate (CAS#8030-30-6) Polymerized organic acids Sulfonate surfactant	Immediate (Acute), Delayed (Chronic), Fire	20-200 bbl (liquids) 50-500 lbs (dry)
Paint and Paint Thinner	Fire, Delayed (Chronic)	5-50 gals
Pipe Joint Compound	Delayed (Chronic)	1-2
Organic Acids Acetic acid (CAS#64-19-7) Acetic anhydride (CAS#108-24-7) Benzoic acid (CAS#65-85-0) Citric acid (CAS#5949-29-1) Formic acid (CAS#64-18-6) Organic acid salts	Immediate (Acute), Fire	2-20
Produced Hydrocarbons Condensate Crude oil (CAS#8002-05-9) Natural Gas	Immediate (Acute), Delayed (Chronic), Fire, Sudden release of pressure	2000-20,000
Proppants Bauxite (CAS#1318-16-7) Resin coated sand Zirconium proppant	Immediate (Acute)	50,000-600,000 lbs.
Resin and Resin Solutions Melamine resins Phenolic resins Polyglycol resins	Immediate (Acute), Fire	1-2

Table C-3. Generic List of Hazardous Chemical Categories for the Oil and Gas Exploration and Production Industry.

Hazardous Chemical Category (With Examples of Representative Chemicals)	Physical and Health Hazards	Approx. Quantity Onsite (BBLS, unless noted otherwise)
Salt Solutions Aluminum chloride (CAS#7446-70-0) Ammonium chloride (CAS#12125-02-9) Calcium bromide (CAS#17626-99-8) Calcium chloride (CAS#10035-04-8) Calcium sulfate (CAS#778-18-9) Ferrous sulfate (CAS#7782-63-0) Potassium chloride(CAS#7447-40-7) Sodium chloride (CAS#7647-14-5) Sodium sulfate (CAS#7757-82-6) Zinc bromide (CAS#7699-45-8) Zinc chloride (CAS#7646-85-7) Zinc sulfate	Immediate (Acute)	2000-20,000
Scale Inhibitors Ethylenediaminetetraacetic acid (EDTA) (CAS#60-00-4) Inorganic phosphates Isopropanol (CAS#67-63-0) Nitrilotriacetic acid (NTA) (CAS#139-13-9) Organic phosphates Polyacrylate Polyphosphates	Immediate (Acute), Fire	20-200
Shale Control Additives Hydrolyzed polyacrylamide polymer Organo-aluminum complex Polyacrylate polymer Sulfonated asphaltic residuum	Immediate (Acute)	20-200
Silica	Immediate (Acute), Delayed (Chronic)	2000-20,000 lbs.

Table C-3. Generic List of Hazardous Chemical Categories for the Oil and Gas Exploration and Production Industry.

Hazardous Chemical Category (With Examples of Representative Chemicals)	Physical and Health Hazards	Approx. Quantity Onsite (BBLS, unless noted otherwise)
Solvents 1,1,1-Trichloroethane (CAS#71-55-6) Acetone (CAS#67-64-1) Aliphatic hydrocarbons Aromatic naphtha (CAS#8032-32-4) Carbon tetrachloride (CAS#56-23-5) Diacetone alcohol Ethylene glycol monobutyl ether (CAS#111-76-2) Kerosene (CAS#8008-20-6) Isopropanol (CAS#67-63-0) Methyl ethyl ketone (MEK) (CAS#78-93-3) Methyl isobutyl ketone (MIBK) (CAS#108-10-1) Methanol (CAS#67-56-1) t-Butyl alcohol (CAS#75-65-0) Toluene (CAS#108-88-3) Turpentine (CAS#8006-64-2) Xylene (CAS#1330-20-7)	Immediate (Acute), Delayed (Chronic), Fire	20-200
Spotting Fluids Nonoil base spotting fluid Oil base spotting fluid (diesel oil base) Oil base spotting fluid (mineral oil base) Sulfonated vegetable ester	Immediate (Acute), Fire	20-200
Surfactants - Corrosive Alcohol ether sulfates Amines Quarternary polyamine Sulfonic acids	Immediate (Acute)	2-20
Surfactants Ethylene Diamine (CAS#107-15-3)	Fire, Immediate (Acute)	2-20
Surfactants - Flammable Amines Ammonium salts Fatty alcohols Isopropanol (CAS#67-56-1) Oxylalkylated phenols Petroleum naphtha (CAS#8030-30-6) Sulfonates	Immediate (Acute), Fire	2-20

Table C-3. **Generic List of Hazardous Chemical Categories for the Oil and Gas Exploration and Production Industry.**

Hazardous Chemical Category (With Examples of Representative Chemicals)	Physical and Health Hazards	Approx. Quantity Onsite (BBLS, unless noted otherwise)
Surfactants - Miscellaneous Amine salts Glycols Phophonates	Immediate (Acute)	2-20
Temporary Blocking Agents Benzoic acid (CAS#65-85-0) Naphthalene (CAS#91-20-3) Petroleum wax polymers Sodium chloride (CAS#7647-14-5)	Immediate (Acute)	2-20
Tracers Ammonium Nitrate Potassium Nitrate	Fire	2-20
Viscosifiers Attapulgite Bentonite Guar gum (CAS#9000-30-0) Sepiolite Xantham gum	Immediate (Acute)	1000-5000 lbs.
Weight Materials Barite (CAS#7727-43-7) Calcium carbonate (CAS#1317-65-3) Galena Hematite (CAS#1317-60-8) Siderite	Immediate (Acute)	10,0000-150,000 lbs.
Welding Materials Solder Welding Rods	Immediate (Acute)	1-1000 lbs.

APPENDIX D

GEOLOGY/PALEONTOLOGY

APPENDIX D

GEOLOGY/PALEONTOLOGY

D.1 GEOLOGY

The precursor to the modern greater Green River Basin developed during the late Cretaceous Period (circa 75 million years ago) and began filling with sediments eroded from surrounding uplifts to the north, east and south. The Utah-Wyoming Thrust Belt began forming west of the area in early Cretaceous time with the development of large scale eastward movement of thick piles of sedimentary rocks along relatively low angle thrust faults in western Utah. Uplift and thrusting progressed eastward throughout the Cretaceous so that by the end of that period and during the succeeding early Paleocene period, thrusting and associated uplift had progressed into southwestern Wyoming.

Sediment accumulated in the greater Green River Basin in a variety of environments throughout the Early Tertiary period related to their distance from the mountain fronts. Near the mountains landslides, mudslides and alluvial fans accumulated coarse-grained sediments. Progressively basin-ward from the mountains, streams, rivers, and ponds or lakes accumulated fine-grained sediments in a broad ancient floodplain and lake basin.

During the Paleocene and early Eocene periods, when sediment supply was high, deposits of rivers and associated ponds accumulated in a broad flood basin that occupied most of the ancient Green River Basin. In the late-early and middle Eocene, when uplift, erosion, and sediment supply diminished, but the basin floor continued to sink, a large lake system developed in the basin center. This ancient lake system, the Green River Lakes, fluctuated dramatically in size, throughout its existence. When lake stands were high, lake deposits expanded to cover most of the basin and river deposits were restricted to the basin edges. When lake stands were low, river deposits expanded to cover most of the basin and lake deposits were restricted to the basin center. Thick, chemically precipitated deposits formed in and around the lake at times of lake restriction.

Periodic oscillation of the level of the ancient lakes resulted in a complex inter-fingering relationship between lake sediments and their laterally equivalent riverine sediments seen in the rock record. During the late middle Eocene, the last Green River Lake filled with chemically precipitated rocks and sediment and riverine deposits of a broad ancient flood basin once again spread across the basin. Large volumes of ash derived from the Absaroka area of northwestern Wyoming periodically blanketed the area and helped fill the lake basin with sediment.

Geologic mapping by the U.S. Geological Survey (USGS) and Wyoming Geological Survey document that sedimentary deposits of Quaternary and early Tertiary age crop out in the analysis area (Love and Christiansen 1985; M'Gonigle and Dover 1992; Dover and M'Gonigle 1993; Love et al. 1993). These exposures are the erosional remnants of more continuous deposits of the greater Green River Basin. Rocks that accumulated in rivers and associated ponds during the early to middle Eocene comprise the Bridger Formation. Rocks that accumulated in the Green River Lakes system during the middle Eocene comprise the Green River Formation. Both formations contain ash beds derived from the Absaroka area.

In places in the analysis area such as along modern river drainages and atop modern terraces and buttes, rocks of the Bridger and Green River Formation are overlain by much younger unconsolidated sediments of Quaternary age. These sediments include alluvium, colluvium, stream terrace and pediment gravels, fan deposits, and wind-blown sand and loess that is late Pleistocene to Holocene in age. Some of these deposits are pre-Wisconsin in age (Mears 1987).

Below the surface, the Moxa Arch area is underlain by Phanerozoic sedimentary rocks, that range from Cretaceous to Cambrian in age. The Phanerozoic sediments are underlain by metamorphic bedrock of Precambrian age which comprises part of the ancient North American cratonic shield.

D.2 PALEONTOLOGY

D.2.1 Applicable Laws, Regulations, and Policies

Scientifically significant fossils are protected by a variety of federal laws, regulations and policies and considered nonrenewable resources by the BLM and other federal land management agencies. Inclusion of fossil resources by federal land agencies in the environmental review process has been dependent in the past chiefly on the knowledge and experience of local agency personnel. This situation, however, changed in 1993, when the BLM developed and implemented standard procedures for evaluating paleontologic resources as part of the environmental process as authorized by NEPA, FLPMA, and other related regulations and guidelines. The BLM has also established specific criteria for the qualifications of paleontologists conducting work on lands under their jurisdiction. Other federal agencies have adopted similar guidelines (Lazerwitz 1994).

As a result, the BLM and other federal agencies now require a Class I (Literature and Records) search by a qualified paleontologist in areas known to contain, or suspected to contain, fossils of scientific interest as part of environmental review. As defined by the BLM Information Bulletin WY-93-371, a qualified paleontologist must have advanced instruction or equivalent training and experience in paleontology and field paleontologic methods. A Class I search may result in the identification of potential adverse impacts of project implementation.

A Class III (Field Survey) search to identify fossil resources and quantify adverse impacts is required prior to construction disturbance in areas identified by the Class I search as having high or unknown paleontologic sensitivity (described here as having high paleontologic potential--see Section 3.4.2.3 for description of terms). A field survey must be completed prior to implementation of the project; a report of findings is completed following the survey. The report of findings details the results of the survey, including a discussion of any fossils collected during the survey, and sets forth a plan to implement the mitigation of adverse impacts to fossil resources. Mitigation measures to reduce adverse impacts are implemented prior to, or in conjunction with, ground disturbance and may include any or all of the following: 1) worker education, 2) monitoring of excavation, 3) collection and sampling of significant fossils, or 4) relocation of excavation to avoid fossils of significance. Fossils collected during the field survey or subsequent mitigation must be curated into an approved museum repository. The supervising, qualified paleontologist for the project is responsible for the assessment and development of the program for mitigation during the initial planning phase, the adequacy of the mitigation measures, and the report of findings as set forth in BLM IB WY-93-371.

D.2.2 Paleontologic Potential Criteria for Geologic Formations

Criteria used to describe the fossil potential of geologic deposits in this investigation are consistent with those contained in BLM Information Bulletin WY-93-371. These criteria are as follows:

High Potential. Sedimentary units with high potential for containing significant paleontologic resources are those which are shown by literature or museum records and by field surveys to have produced (or are very likely to produce) vertebrate fossils or significant invertebrate or plant fossils. Units with high potential may be so designated throughout their extent or only in areas/lithologies that are especially productive. Fossils need not be uniformly productive; they may produce only a few highly significant fossils that provide new taxonomic, phylogenetic, ecologic, and/or stratigraphic data.

Low Potential. Sedimentary units that have been studied may be found through literature, museum records, and field surveys to have produced few significant fossils. These units are judged by a qualified paleontologist are unlikely to produce significant fossils in the course of surface disturbance.

Unknown (Undetermined) Potential. Sedimentary units for which no known, published, or unpublished information exists have undetermined potential for producing significant paleontologic resources. Field survey is to be performed by a qualified paleontologist to make a specific determination of high or low potential and to develop a program of mitigation as necessary.

Although BLM guidelines do not specifically recognize geologic deposits as having no paleontologic potential, some deposits, such as non-fossil-bearing intrusive or extrusive igneous rocks, metamorphic rocks, and modern sediments that are clearly too young to contain fossils effectively have no paleontologic potential.

Paleontologic Potential. Paleontologic potential, as described above and used here, is a broad measure of the likelihood for a geologic deposit to contain scientifically significant, nonrenewable fossil resources as determined by Class I search. Paleontologic potential should be differentiated from paleontologic sensitivity which, as defined here, is a more specific measure of the ability of a geologic deposit to produce significant fossils based on a Class III search. Usually an area of high fossil sensitivity is only a small fraction of the area of high paleontologic potential. For example a geologic deposit is assigned a high paleontologic potential based on the occurrence of scientifically significant fossils anywhere in its distribution, but field survey may reveal the lithology of the deposit in any given area is not conducive to preservation. As a result, a deposit assigned a high potential might actually have a low sensitivity in specific areas, but this can only be demonstrated by field survey.

Paleontologic Localities. Paleontologic localities are locations where fossils have been discovered and recorded. The definition of a locality is variable and can include a specific location, a specific area, or a specific bed within a formation. Localities referred to here within the Green River Formation comprise distinct layers that occur over a widespread area, whereas those within the Bridger Formation comprise specific ground locations.

D.2.3 Geologic Deposits with High Paleontologic Potential

D.2.3.1 Unnamed Quaternary Sediments

With the exception of terrace gravels and pediment deposits, none of the Quaternary deposits listed in Table D-2 are thought to be old enough to contain significant fossils. These deposits of Pleistocene age are known to produce significant fossils including the remains of Pleistocene megafauna such as mammoths, mastodonts, camels and other artiodactyls, native horses, sloths, carnivores at widespread localities throughout the western United States. These fossils are not common in terraces deposits in

Wyoming. For that reason, while these deposits have some potential to produce fossils, the potential is considered low. Geomorphic evidence, including remnant periglacial features, indicates that some of the terrace deposits are pre-Wisconsin in age (Mears 1987). Radiometric dates associated with archaeological site date dunal sands in the Opal Dune Field as late Altithermal in age, or about 6,300 years old (Ahlbrant cited in Mears 1987). Thus, these deposits are considered old enough to contain significant fossils.

D.2.3.2 Bridger Formation

Exposures of the Bridger Formation comprise most of the surface of the analysis area. The formation consists of light and medium gray to green-gray mudstone, claystone, siltstone, and sandstone with minor interbeds of light-gray and green tuff and tan to light-pink limestone and marlstone and thin lignites and coals. Pink or red sediments are present but restricted. The Bridger Formation inter-fingers with the Laney Member of the Green River Formation described below and is divided into an upper and lower unit by a tongue of that member. Deposits above the tongue comprise the Main Body of the Bridger Formation and those below comprise the Whiskey Butte Bed (Sullivan 1980).

The Bridger Formation has traditionally been subdivided stratigraphically into subunits A-E by conspicuous white layers composed of either ash, limestone, or both (Sinclair 1906; Matthew 1909; Koenig 1960; Bradley 1964; McGrew and Sullivan 1970). Only Bridger A and B are preserved in the Moxa Arch area. The Main Body includes parts of Bridger A and B and the Whiskey Butte Bed includes only Bridger A. The boundary between Bridger A and Bridger B is placed at the "G-marker bed" (McGrew and Sullivan 1970), a widespread light-brown to gray, ostracodal limestone, which occurs approximately 10 to 100 feet above the Laney Tongue separating the Main Body and Whiskey Butte Bed. Locally, the marker bed preserves algal mounds that exceed a few feet high and 15 feet across. At least five other invertebrate fossil-rich limestone marker horizons have been mapped in the area and these serve to stratigraphically subdivide the lower Bridger Formation more precisely. Two of these occur in the Bridger B and three in the Bridger A. The ash bed also seems to be particularly rich in vertebrate fossils (Robinson 1994).

Fossil vertebrates have been collected from the Bridger Formation for more than 120 years (Leidy 1869 and 1871; Matthew 1909; West 1976 and 1990; Gunnell and Bartels 1994) and collections of these specimens are housed at nearly every major paleontology museum in the world. Tables D-1 and D-2 provide information about fossil localities found within the area and specimens recovered from them recorded in the collections of The Geology Museum at the University of Wyoming (Laramie); The Museum of Paleontology at the University of Michigan (Ann Arbor); University Museum of the University of Colorado (Boulder), USGS (Denver), and Loma Linda University (Loma Linda). The Museum of Paleontology at the University of Michigan also houses specimens from, and locality records for, collections of the Milwaukee Public Museum made by Dr. Mac West. Although this locality list is not all-inclusive, the fossil richness of the Bridger Formation in the area is well-documented by these localities.

Most known fossil specimens from the Bridger Formation have been collected from the Bridger B and above. The Bridger A had been largely neglected by paleontologists until a few years ago. Major work began on the Bridger A during the 1960s. Dr. Paul O. McGrew, a former Professor of Paleontology at The University of Wyoming, began studying the unit (McGrew and Bown 1977). Following McGrew's initial prospecting and collecting efforts, Wood (1966) and Pledge (1969) studied the paleontology and stratigraphy of the lower Bridger Formation (primarily Bridger B) in detail. Later McGrew and Sullivan (1970) described the stratigraphy and geology of the Bridger A and summarized all previous work. They measured 12 sections of the unit in the Opal-Granger area, and tied 35 fossil vertebrate bearing localities to these sections. Until recently, their publication was the most comprehensive study of the Bridger A.

Recent work on the Bridger A has been conducted by joint field expeditions by Albion College and The University of Michigan led by Drs. William Bartels and Gregory Gunnell, respectively. This joint expedition has thus far documented the presence of 43 genera of fossil mammals (Table D-3), 18 genera of reptiles, and at least two genera of fish in the rocks of the unit of the area (Bartels 1991; Gunnell and Bartels 1994). Paleontologic investigations on the Bridger Formation in the Opal-Granger area related to environmental clearance include that of Dames & Moore (1992) and Erathem-Vanir (1990 a and b, 1993).

Among fossil animals found in the Bridger A, *Lepisosteus* (gar pike) and *Amia* (bowfin) are the most commonly found fish and *Echmatemys* and *Hybemys* (emydids) are the most commonly found turtles. Trionycid (soft-shelled) turtles are also common fossils in the unit, as are the crocodilian taxa *Diplocynodon* and *Crocodylus*. Many of the aquatic reptiles recovered from units in the Opal-Granger area are notable for their large size. For example, many of the crocodiles have exceeded four meters in length and the soft-shelled turtles and fish have exceeded a meter in length (Bartels 1991).

On-going work supports the ideas of earlier workers that the Bridger A accumulated during a time of warm and humid conditions when dense forests prevailed. Information gathered from the fossils they have collected is scientifically significant in that it allows more detailed refinement of regional biostratigraphy for the early part of the Bridgerian Land Mammal Age as well as providing information on the nature of the biota that inhabited the area during that time. This later information may be critical to reconstructing the evolutionary pathway or phylogeny for extinct and extant organisms.

The Bridger B includes that part of the formation between the "G marker bed" (below) and Sage Creek White Layer (above). The lower parts of the unit are similar to Bridger A in terms of lithology and types of preserved fossils. Much of the paleontologic work on Bridger B has concentrated south and east of the area, where exposures of the unit are more extensive. This work has been conducted by researchers from the Milwaukee Public Museum (West a-c, 1974, 1976 1973) in the 1970s and more recently by researchers from The University of Colorado-Boulder (Robinson 1994) and Denver Museum of Natural History (Stucky 1994) and Loma Linda University (Brand 1995).

D.2.3.3 Green River Formation

The Green River Formation is represented in the Moxa Arch area by the Laney Shale Member of middle Eocene age. The Laney Member forms the top of the Green River Formation and records in its sediments the greatest expansion of ancient Lake Gosiute followed by its final restriction and desiccation. At its peak, the lake in which the Laney Member accumulated occupied more than 75 percent of the Greater Green River Basin, or an area of about 15,000 square miles (Roehler 1992, 1993). In the analysis area, the Laney overlies the Wasatch Formation of early Eocene age and consists of tan and brown silty algal limestone and ostracodal marlstone containing thin light-gray fine to coarse grained sandstone interbeds. The Laney is divided into an upper and lower unit by the Whiskey Butte Member of the Bridger Formation. The lower part (Tgll), or Craven Creek Bed, as named by Sullivan (1980), consists of as much as 110 feet of buff-colored silty shale, laminated siltstone, and sandstone with occasional interbeds of marlstone. The shale is typically dolomitic and contains the remains of fish, mollusks, ostracods, and plants (Surdam and Wolfbauer 1975). The upper part (Tglu), or Cow Hollow Bed, as named by Sullivan (1980) for exposures along Cow Hollow Creek, consists of as much as 50 feet of buff weathering shale, marlstone, sandstone, and siltstone similar in appearance to the Craven Creek Bed.

Scientifically significant fossils have been known from the Green River Formation for more than 150 years (Grande 1984), the first discovery of fossil fish being made by a geologist, Dr. John Evans near Green River, Wyoming. The specimen was sent to Joseph Leidy in Philadelphia and identified as a herring, *Clupea humilus*, in 1856, but was subsequently renamed *Knightia eoceaena*, which has since become Wyoming's state fossil. Since this early discovery, many collections of fossil fishes, other vertebrates, insects and plants have been made from the formation and the specimens are world renown for their preservation. Collections of specimens from the formation are housed in many major museums around the world and sold in rock shops across the United States.

Fossils, data on specific fossil localities, or both found in the Laney Member in the Moxa Arch area are housed at The Geology Museum at the University of Wyoming (Laramie); University Museum of the University of Colorado (Boulder), and Loma Linda University (Loma Linda). Information from these institutions and at the Field Museum, document the fossil richness of the Laney Member in the area. The lower 60 to 100 feet of the Laney can be expected to produce abundant and significant fossils wherever it is present (Grande 1995; Buchheim 1995; Buchheim and Surdam 1977 and 1981). The member of the formation produces fossils from four major localities (G-1 to G-4) that comprise distinct layers that occur over wide parts of the Green River Basin. Locality G-1 occurs widely over the analysis area in the lower part of the Laney. Localities G-2 and G-3 (Hayden's "Petrified Fish Cut") and G-4 (Farson Fish) occur in the member elsewhere. Locality G-1 includes bluish, grayish tan or brown to buff quartz-rich, shaley dolomite that outcrops near water level along the shores of the Fontenelle Reservoir (Grande 1984).

Fossil vertebrates known from locality G-1 are listed in Table D-4. In addition to fish, the remains of amphibians, reptiles, birds, invertebrates and plants are known from the locality. Plant and insect fossils are very common. The most common insect fossil is the mosquito (*Culex* spp.), which comprises more than 98 percent of the known fauna. A wide variety of other invertebrates are known from the locality and throughout the Laney Member including other insects, ostracods, mollusks, and gastropods. Numerous plant fossil occur in the locality, with the remains of sycamore (*Plantanus* spp.) and scouring rush (*Equisetum* spp.) being most common (MacGinitie 1969). The remains of algal mounds or stromatolites occur elsewhere in the member and may exceed a few feet high and 15 feet across.

Among vertebrates, the most common fish at the locality include the herring genera *Knightia* and *Gosiutichthys*. The average size of the fish specimens from the locality is smaller than other localities probably because of the very shallow depth of Lake Gosiute at the time the G-1 layer was deposited. Birds, salamanders, turtles, and crocodilians are found only rarely in the locality. At least one complete articulated turtle and a two nearly complete crocodilian skeleton are known from the locality. The remains of small perching birds, primobucconids are also known from the locality, but the most abundant bird remains are the impressions of feathers.

Near the Fontenelle Dam, the Laney Member consists of thick sandstones inter-laminated carbonates, mudstones, and stomatolite units. The thick sands contain masses of compressed fossil logs and some of the finer-grained carbonates contain fossils of reed stem (*Typha* spp.), juvenile fish (*Knightia*) and leaves of higher plants. The carbonates also contain the fossil remains of the catfish *Astephus*, herring-like *Diplomystus*, sucker *Amyzon*, and genus *Asinops* of uncertain affinities (Buchheim and Surdam 1981).

These fossil fish and those at Locality G-1 include some of the earliest known representatives of the catfish and sucker families.

Table D-1. Fossil Localities within Bridger Formation, Moxa Arch Area and Vicinity.

7.5 Minute Quadrangle	Locality	Location		
		Section	Township	Range
Antelope Knoll	BRW-412	34	18N	111W
Church Butte	V-68006	24	18N	114W
	EBL-80-3*	35	18N	113W
	BB-55	10	18N	113W
	BRW-279	16	18N	113W
	BRW-280	17	18N	113W
	BB-65	19	18N	113W
	BRW-278	21	18N	113W
	BRW-277	22	18N	113W
	BB-84, BRW-146, BRW-284	23	18N	113W
	BB-56, BB-83, BB-91, UC-91001, UC-93073 to UC-93075	26	18N	113W
	BB-66	19	19N	113W
	BB-65	34	19N	113W
Church Butte NW	V-80092	16	19N	113W
	V-67004, V-67005	1	20N	114W
	V-67003	2	20N	114W
Cow Hollow Creek	UC-92063	9	21N	113W
	UC-92065	19	21N	113W
	V-66029	8	22N	112W
	V-66031	30	22N	112W
	V-65006	31	22N	112W
	BB-21	22	22N	113W
	V-64002, V-65002, V-65005	33	22N	113W
	BB-48, BB-49	33	22N	113W
	BB-20, BB-53	34	22N	113W
	V-65003, V-65004, BR-50, UC-92064	35	22N	113W
	V-64003, V-64004	36	22N	113W
Fontenelle	V-69013	29	23N	111W
Fontenelle SE	V-66027	30	21N	111W
Fontenelle Reservoir SE	LL-1	10	24 N	112W
	V-80103	11	24N	112W
Fontenelle Reservoir SW	LL-2	31	25N	112W

Table D-1. Fossil Localities within Bridger Formation, Moxa Arch Area and Vicinity, Continued.

7.5 Minute Quadrangle	Locality	Location		
		Section	Township	Range
Granger	V-80089	12	18N	111W
	V-55001	13	18N	111W
	BRW-336	34	18N	111W
	UC-91346	14	19N	111W
Millersville	UC-93060	1	17N	113W
	UC-92201, UC-93057, UC-93058, UC-93059, UC-93062, UC-93069	2	17N	113W
	UC-92195, UC-93063 to UC-93-068			
	UC-92197	11	17N	113W
	UC-92196, UC-92198 to UC-92-200, UC-93050 to UC-93055, UC-93061, UC-93070, UC-93071	13	17N	113W
	UC-93056	14	17N	113W
	BRW-282	15	17N	113W
	BRW-283	10	18N	113W
	BRW-281	15	18N	113W
	BRW-284	18	18N	113W
	1 unnumbered V, UC-83109	23	18N	113W
		34	18N	113W
Moxa	V-66030	33, 34	18N	113W
Opal	BB-40, BB-47, BB-95	32	22N	113W
The Palisades	LL-3	6	24N	113W
Verne	BRW-355, BRW-356, BRW-406, BRW-407	23	18N	112W
	V-80093	5	18N	113W
	V-80090	12	18N	113W
	V-80094	32	19N	113W
Whiskey Butte	1 unnumbered**	22	22N	111W
	4 unnumbered**	26	22N	111W
	7 unnumbered**	36	22N	111W

Table D-1. Fossil Localities within Bridger Formation, Moxa Arch Area and Vicinity, Continued.

7.5 Minute Quadrangle	Locality	Location		
		Section	Township	Range
Wildcat Butte	V-68009, V-68019	8	16N	112W
	V-68002	2	16N	113W
	LL***	1	17N	113W
	LL***	2	17N	113W
	LL***	11	18N	113W
	LL***	12	16N	113W
	LL***	11	16N	112W
	LL***	16	16N	112W
	LL***	20	16N	112W
	LL***	21	17N	112W
	LL***	26	17N	112W
	LL***	29	17N	112W
	LL***	30	17N	112W
	LL***	35	17N	112W
	BRW-334	11	17N	113W
	LL***	25	17N	113W
	LL***	36	17N	113W
	BB-111	30	18N	113W
	BRW-276	36	18N	113W

* Mapco Pipeline Locality of Lander

** Report written by Dr. J. A. Lillegraven (University of Wyoming) to Mr. Gary Simmons, Exxon

*** Loma LInda Bridger Locality; no specifics given (Brand 1995).

Databases: Geology Museum, University of Wyoming (V); Museum of Paleontology, The University of Michigan (BB) (including those of The Milwaukee Public Museum =BRW); University Museum, University of Colorado (UC), Loma Linda University (LL)

Table D-2. Information on Specific Fossil Localities Moxa Arch Analysis Area.

Locality	Reported Land Status	Formation	Notes (specific reference to specimens if known)	Reference (if any available)
V-55001	private	Bridger	miscellaneous fossils	McGrew and Cleven, 1955
V-64002	private	Bridger	skull jaws and post cranials of a Taeniodont	Wood (1967)
V-64003	Federal	Bridger	jaw of *Smilodectes*	Wood (1967)
V-64004	private	Bridger	jaw of *Microsyops*	Wood (1967)
V-65002	private	Bridger	rodent molars, coprolites, above S-white layer, carnivore (*Tritemnodon*) jaws, skull and postcranials	Wood (1967)
V-65003	private and Federal	Bridger	fossils of primates, rodents, *Orohippus*, carnivore mandible	Wood (1967)
V-65004	private	Bridger	fossils of primates, rodents, trionychid turtles, *Paleosyops*, *Hyopsodus*	Wood (1967)
V-65005	private	Bridger	fossils of *Microsus* and *Sciuravus*	Wood (1967)
V-65006	private	Bridger	vertebrate fossils including rodent incisor	Wood (1967)
V-66027	Federal	Bridger	miscellaneous vertebrate fossils	Wood (1967)
V-66029	Federal	Bridger	miscellaneous vertebrate fossils	found by P.O. McGrew and class 1966

Table D-2. Information on Specific Fossil Localities in the Moxa Arch Area, Continued.

Locality	Reported Land Status	Formation	Notes (specific reference to specimens if known)	Reference (if any available)
V-66030	Federal	Bridger	miscellaneous vertebrate fossils	found McGrew and Roehler year unknown
V-66031	Federal	Bridger	UW 3155 skull of *Crocodilus* cf. *C. affinis*	
V-67003	private	Bridger	miscellaneous vertebrate fossils	Pledge (1969)
V-67004	private	Bridger	miscellaneous vertebrate fossils	
V-67005	private	Bridger	miscellaneous vertebrate fossils	
V-68002	Federal	Bridger	120' below Sage Creek White layer	P.O. McGrew 1968
V-68006	unknown	unknown	miscellaneous vertebrate fossils	
V-68009	Federal	Bridger	continuation of V-68010	P.O. McGrew 1968
V-68010	Federal	Bridger	abundant fossil microfauna 180" below Sage Creek White Layer	P.O. McGrew 1968
V-69001	Federal	Wasatch?	miscellaneous vertebrate fossils	Simnacher (1970)
V-69012	private	Bridger	miscellaneous vertebrate fossils	

Table D-2. Information on Specific Fossil Localities in the Moxa Arch Area, Continued.

Locality	Reported Land Status	Formation	Notes (specific reference to specimens if known)	Reference (if any available)
V-69013	Federal	Bridger	crocodile skull	
V-80089	Federal	Bridger	microvertebrates, inverts, fish, turtles, lizards, birds, mammals and algal mats	Lander (Mapco Pipeline survey)
V-80090	Federal	Bridger	miscellaneous vertebrate fossils	Lander (Mapco Pipeline Survey)
V-80092	Federal	Bridger	miscellaneous vertebrate fossils	Lander (Mapco Pipeline survey)
V-80093	Federal	Bridger	rodent jaw	Lander (Mapco Pipeline survey)
V-80094	Federal	Bridger	abundant small mammal fossils	Lander (Mapco Pipeline survey)
V-80103	Federal	Green River	Locality G-1 of Grande (1984)	Grande (1980)
BB-20	Federal	Bridger A	22 mammalian and three reptilian taxa, locality considered very important	Gunnell (1994)
BB-21	Federal	Bridger A	single mammalian specimen	Gunnell (1994)
BB-40	Federal	Bridger A	four mammalian taxa locality considered important	Gunnell (1994)
BB-47	Federal	Bridger A	two mammalian taxa	Gunnell (1994)

Table D-2. Information on Specific Fossil Localities in the Moxa Arch Area, Continued.

Locality	Reported Land Status	Formation	Notes (specific reference to specimens if known)	Reference (if any available)
BB-48	Federal	Bridger A	one mammalian taxa	Gunnell (1994)
BB-50	Private	Bridger A	seven mammalian taxa, one reptilian taxon locality considered important	Gunnell (1994)
BB-53	Federal	Bridger A	two mammalian taxa, one reptile taxon	Gunnell (1994)
BB-55	Federal	Bridger B	10 mammalian taxa	Gunnell(1994)
BB-56	Federal	Bridger B	eight mammalian taxa	Gunnell (1994)
BB-65	Federal	Bridger A	one mammalian and one reptilian taxa	Gunnell (1994)
BB-66	Private	Bridger A	two mammalian taxa, one fish taxon	Gunnell (1994)
BB-83	Federal	Bridger B	24 mammalian taxa, one reptile taxa, locality considered very important	Gunnell (1994)
BB-84	Private	Bridger B	4 mammalian taxa	Gunnell (1994)
BB-91	Federal	Bridger B	21 mammalian taxa, three reptilian taxa, locality considered very important	Gunnell (1994)
BB-95	Federal	Bridger A	three mammalian taxa	Gunnell (1994)

Table D-2. Information on Specific Fossil Localities in the Moxa Arch Area, Continued.

Locality	Reported Land Status	Formation	Notes (specific reference to specimens if known)	Reference (if any available)
UC-83109 UC-91001 UC-91346 UC-92196 UC-92198 UC-92199 UC-92200 UC-92201 UC-93050 UC-93051 UC-93052 UC-93053 UC-93054 UC-93055 UC-93056 UC-93057 UC-93058 UC-93059 UC-93061 UC-93062 UC-93069 UC-93070 UC-93071 UC-93073 UC-93074 UC-93-75	Federal	Bridger B	fossils from Blacks Fork Member, lower Bridger B	Robinson (1995)

Table D-2. Information on Specific Fossil Localities in the Moxa Arch Area, Continued.

Locality	Reported Land Status	Formation	Notes (specific reference to specimens if known)	Reference (if any available)
UC-92063 UC-92195 UC-92197 UC-93060 UC-93063 UC-93064 UC-93065 UC-93066 UC-93067 UC-93068	Private	Bridger B	fossils from Blacks Fork Member, lower Bridger B	Robinson (1995)
UC-92093	Private	Bridger Fm	turtle carapace fragments	Covert (1992), Robinson (1995)
UC-92064	Private	Bridger Fm	large mammal tooth fragments, turtle, crocodile, fish	Covert (1992), Robinson (1995)
UC-92065	Private	Bridger Fm	turtle carapace fragments	Covert (1992)
LL-1, LL-2, LL-3		Green River Fm	Fossil fish, ostracods, plants	Rasmussen (1983), Buchheim (1984), Buchheim and Surdam (1981)

APPENDIX E

CULTURAL RESOURCES

Table E-1. Data Recovery Sites in the Expanded Moxa Arch Analysis Area.

Site	C14 Date	Fauna	Flora	Season	Reference
48UT122 Gemma	1480-1740 BP	small-medium mammal jackrabbit (1) egg shell	oak sunflower Jerusalem artichoke buffaloberry prickly pear	spring-early summer	Pastor in prep.
48UT390 Austin Wash	809 AD	bison (2) antelope (15) 6-7 yrs jackrabbit (2) canid	goosefoot (65) strawberry (70) peppergrass (15)	late fall-early winter	Schroedl 1985
48UT199	490 AD	antelope (2) jackrabbit (1) cottontail	Chenopodium (2) no pollen analyzed	mid-late summer	Schroedl 1985
	1410 BP	bison (1) antelope (4) jackrabbit (1) cottontail (2) prairie dog (2) ground squirrel (4) pocket gopher (6) wood rat (1) vole (1)	Chenopodium (2) no pollen analyzed	unknown	Schroedl 1985
	4840 BP	antelope (1) bison (1) cottontail (1)	Chenopodium (2) no pollen analyzed	summer	Schroedl 1985
48UT779	860 AD	antelope jackrabbit cottontail prairie dog ground squirrel gopher egg shell mussel	Chenopodium(s) strawberry(s) sunflower(s) willow(s) (461 total seeds) no pollen analyzed	mid-late summer	Schroedl 1985

Table E-1. Data Recovery Sites in the Expanded Moxa Arch Analysis Area, Continued.

Site	C14 Date	Fauna	Flora	Season	Reference
48UT779	4720 BP	antelope (1) egg shell	no seeds or pollen analyzed	late spring-early summer	Schroedl 1985
48UT370	5300 BP (approx)	antelope (1) jackrabbit (1) cottontail (1) ground squirrel (2) prairie dog (2) pocket gopher (5) chipmunk (1)	no seeds present no pollen analyzed	unknown	Schroedl 1985
48UT445	930 BP	rabbit (1) small-medium mammal	Chenopodium (24) peppergrass (1) Indian ricegrass (1) no pollen analyzed	unknown	Schroedl 1985
48UT401 Porter Hollow	220-2400 BP	bison (1) antelope (1) egg shell	no seeds no pollen	late spring-summer	Hoefer 1987
48LN1697 White Fish	1830 BP	pronghorn prairie dog	beeweed (3)	late summer	Smith 1987
48LN1468 Taliaferro	990 AD	bison deer antelope (2) jackrabbit (2) cottontail mussel	goosefoot (5+) saltbush (5+) monolepis (5+) sedge (3+) ricegrass (3+) lily (1+) cattail cinquefoil (1+)	late spring-late summer	Smith and Creasman 1988

Table E-1. Data Recovery Sites in the Expanded Moxa Arch Analysis Area, Continued.

Site	C14 Date	Fauna	Flora	Season	Reference
48LN1468 Taliaferro	780 AD	deer antelope (2) jackrabbit cottontail muskrat sage grouse sucker mussel egg shell	goosefoot (1500+) beeweed (200+) mustard (20+) sedge (20+) greasewood (5+) saltbush (5+) globemallow (5+) sumpweed (5+) grass (5+) lily	late spring-late summer	Smith and Creasman 1988
	640 AD	deer antelope (2) jackrabbit (2) cottontail sage grouse mussel egg shell	goosefoot (1000+) saltbush (25+) buttercup (5+) sunflower (5+) mustard (5+) lily (5+) sedge (10+) beeweed (100+) grass (5+)	late spring-late summer	Smith and Creasman 1988
	450 AD	bison antelope jackrabbit (2) cottontail muskrat sage grouse sucker mussel egg shell	goosefoot (1000+) saltbush (30+) monolepis (30+) beeweed (200+) ricegrass (10+) strawberry (2+) sedge (30+) sunflower (30+) mustard (30+)	late spring-late summer	Smith and Creasman 1988
	2580-2590 BP	bison (1) antelope (1) small mammal	Chenopodium (31) mustard (1) cheno-ams lily	summer-late summer	Smith and Creasman 1988

Table E-1. Data Recovery Sites in the Expanded Moxa Arch Analysis Area, Continued.

Site	C14 Date	Fauna	Flora	Season	Reference
48LN1468 Taliaferro	4500 BP	large mammal small mammal mussel shell	none	unknown	Smith and Creasman 1988
48LN1468 Taliaferro	5290 BP	large mammal	sedge (1) prickly pear willow	summer	Smith and Creasman 1988
48LN127 Cow Hollow	Middle Archaic	medium-large mammal antelope	unknown	unknown	Schock 1982
	3455 BP	medium-large mammal antelope cottontail	unknown	unknown	Schock 1982
	Late Archaic	small-medium-large mammal bison antelope deer jackrabbit	unknown	unknown	Schock 1982
	1280 BP	medium-large mammal bison antelope deer jackrabbit ground squirrel gopher	unknown	unknown	Schock 1982
48LN1738	5410 BP	jackrabbit (2) medium mammal large mammal	cheno-ams (2) grass prickly pear mustard	summer	Hoefer and Darlington 1991
	3920 BP	small-medium mammal	cheno-ams	summer	Hoefer and Darlington 1991

Table E-1. Data Recovery Sites in the Expanded Moxa Arch Analysis Area, Continued.

Site	C14 Date	Fauna	Flora	Season	Reference
48LN1733	3380 BP	small mammal	cheno-ams	summer	Hoefer and Darlington 1991
48LN1185	3590 BP	jackrabbit (1) medium-large mammal	high frequency of artemisia	summer	Hoefer and Darlington 1991
48LN373	920 AD	bison medium-large mammal cottontail jackrabbit	no seeds or pollen analyzed	summer	Wheeler et al. 1986
	780 AD	bison (1) small-large mammal antelope cottontail jackrabbit egg shell	Chenopodium (12) no pollen analyzed	late spring-late summer	Wheeler et al. 1986
	160 AD	bison (1) medium-large mammal cottontail jackrabbit	Chenopodium (6) cattail rose sedge grass Mormon tea	mid-late summer	Wheeler et al. 1986
	90 AD	medium-large mammal cottontail	Chenopodium (1) no pollen analyzed	mid-late summer	Wheeler et al. 1986
	2960 BP	small-large mammal antelope cottontail jackrabbit egg shell bison (1)	Chenopodium (167) cattail rose mustard sedge primrose	mid-late summer	Wheeler et al. 1986

Table E-1. Data Recovery Sites in the Expanded Moxa Arch Analysis Area, Continued.

Site	C14 Date	Fauna	Flora	Season	Reference
48LN373	3780 BP	medium mammal cottontail fish	Chenopodium (30) no pollen analyzed	mid-late summer	Wheeler et al. 1986
	4430-3800 BP	small-large mammal antelope cottontail bird fish	Chenopodium (187) no pollen analyzed	mid-late summer	Wheeler et al. 1986
	<5240 BP	cottontail	no seeds or pollen analyzed	unknown	Wheeler et al. 1986
	<5240 BP	small-large mammal cottontail jackrabbit	Chenopodium (72) no pollen analyzed	summer	Wheeler et al. 1986
	5240 BP	small-large mammal cottontail jackrabbit bison (?)	Chenopodium (72) Indian ricegrass mustard grass Mormon tea	mid-late summer	Wheeler et al. 1986
	5530 BP	small-large mammal cottontail jackrabbit egg shell bison (?)	Chenopodium (8) sand dropseed mustard grass	late summer	Wheeler et al. 1986
	6000 BP	large mammal medium mammal cottontail egg shell	Chenopodium (1) no pollen analyzed	mid-late summer	Wheeler et al. 1986
48LN1334	Component 1 6330 BP	antelope (1) jackrabbit (1)	unknown	unknown	Wheeler et al. 1986

Table E-1. Data Recovery Sites in the Expanded Moxa Arch Analysis Area, Continued.

Site	C14 Date	Fauna	Flora	Season	Reference
48LN1334	Component 2 5650 BP		unknown	unknown	Wheeler et al. 1986
	Component 3 5060 BP	antelope (1) jackrabbit (1) cottontail	unknown	unknown	Wheeler et al. 1986
	Component 4 <5000 BP	unknown	unknown	unknown	Wheeler et al. 1986
	Component 5 <5000 BP	jackrabbit	unknown	unknown	Wheeler et al. 1986
	Component 6 <5000 BP	antelope cottontail jackrabbit	unknown	unknown	Wheeler et al. 1986
	Component 7 <5000 BP	unknown	unknown	unknown	Wheeler et al. 1986
48LN919	2870 BP	none	none	unknown	Wheeler et al. 1986
48LN1404	5480 BP	none	Chenopodium	unknown	Schroedl 1985
48LN1296 Area A	5150 BP	unidentified	none no pollen analyzed	unknown	Wheeler et al. 1986
Area B	1240 BP	unidentified 2 human burials	none no pollen analyzed	unknown	Wheeler et al. 1986
Area E	Component 4 980 BP		Chenopodium ricegrass grasses Amaranth bistort	unknown	Wheeler et al. 1986

Table E-1. Data Recovery Sites in the Expanded Moxa Arch Analysis Area, Continued.

Site	C14 Date	Fauna	Flora	Season	Reference
Area E	Component 3 1460 BP	bison antelope coyote ground squirrel Bovid Bighorn sheep prairie dog	Chenopodium Amaranth ricegrass	unknown	Wheeler et al. 1986
	Component 2 1590 BP	bison antelope elk ground squirrel pocket gopher	Chenopodium ricegrass	unknown	Wheeler et al. 1986
	Component 1 3750 BP	Bovid cottontail Ovis	Chenopodium	unknown	Wheeler et al. 1986
48SW1242	405 AD	bison deer antelope jackrabbit (2) cottontail goose rodent sage grouse egg shell (grouse)	Chenopodium (7) monolepis (71) atriplex (8) cheno-ams sunflower mustard legume	late spring-late summer	Hoefer 1986
	2170 BP	jackrabbit cottontail	cheno-ams legume cattail biscuitroot	late spring-late summer	Hoefer 1986
48SW1612 MAK	1950 BP	small-medium mammal cottontail (1) pocket gopher (1)	Chenopodium Cheno-ams rabbitbrush	spring ?	Thompson and Pastor 1991

Table E-1. Data Recovery Sites in the Expanded Moxa Arch Analysis Area, Continued.

Site	C14 Date	Fauna	Flora	Season	Reference
48SW1612 MAK	Late Prehistoric	small-medium mammal medium-large mammal pronghorn (1) jackrabbit (1) cottontail (1) ground squirrel (1)	Cheno-ams	spring ?	Thompson and Pastor 1991
48SW1023 Arthur	2750 BP	medium-large mammal pronghorn cottontail gopher ground squirrel	Chenopodium (8) no pollen analyzed	unknown	Thompson and Pastor 1991
	3540 BP	medium-large mammal jack rabbit squirrel	Chenopodium (1) squawbush rabbitbrush	unknown	Thompson and Pastor 1991
	6320 BP	small-medium mammal jackrabbit	Chenopodium	unknown	Thompson and Pastor 1991
48SW2302	1300 BP	pronghorn jackrabbit gopher cottontail ground squirrel gopher	Chenopodium Cheno-ams	unknown	Tucker 1985
48SW1560	1470 BP	small mammal (25) medium mammal (35) large mammal (49) jackrabbit (1) cottontail (4) egg shell (63) antelope (1) bison (1) sage grouse (1) ground squirrel (3)	Chenopodium (1) Indian ricegrass (1)	early-mid-summer	Hoefer et al. in prep.

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APPENDIX F

USDI FISH AND WILDLIFE SERVICE COORDINATION LETTERS

March 3, 1849

United States Department of the Interior

TAKE PRIDE IN AMERICA

FISH AND WILDLIFE SERVICE
Ecological Services
4000 Morrie Avenue
Cheyenne, WY 82001

IN REPLY REFER TO:

ES-61411
spb/W.02(blmoxamc.spl)

May 12, 1994

Ms. Juli Elayne Crane
Ecotone Environmental Consulting
123 East 200 North
P.O. Box 3516
Logan, UT 84321

Dear Ms. Crane:

Thank you for letter of April 26, received by this office on April 29, regarding Amoco Production Company's efforts in the Kemmerer Resource Area of southwestern Wyoming.

In accordance with section 7(c) of the Endangered Species Act of 1973, as amended (ESA), my staff has determined that the following threatened or endangered (T/E) species may be present in the project area.

SPECIES	STATUS	EXPECTED OCCURRENCE
Black-footed ferret (Mustela nigripes)	Endangered	Potential resident in prairie dog (Cynomys sp.) colonies.
Bald eagle (Haliaeetus leucocephalus)	Endangered	Nesting along Green River. Winter resident. Migrant.
Peregrine falcon (Falco peregrinus)	Endangered	Migrant.

If your proposed action will lead to water depletion (consumption) in the Colorado River System (which includes the Green River drainage), you should include the following species in your evaluation:

Colorado squawfish (Ptychocheilus lucius)	Endangered	Downstream resident of Green River System.
Humpback chub (Gila cypha)	Endangered	"
Bonytail Chub (Gila elegans)	Endangered	"
Razorback sucker (Xyrauchen texanus)	Endangered	"

Candidate species that may occur within the project area are identified below. Many Federal agencies have policies to protect candidate species from further population declines. I would appreciate receiving any information available on the status of these species in or near the project area.

SPECIES	CATEGORY*	EXPECTED OCCURRENCE
Mammals		
Preble's shrew *Sorex preblei*	2	Sagebrush/bunchgrass habitats in western Wyoming
Pygmy rabbit *Brachylagus idahoensis*	2	Sagebrush stands in SW Wyoming
Birds		
White-faced ibis *Plegadis chihi*	2	Wetlands statewide
Ferruginous hawk *Buteo regalis*	2	Grasslands statewide
Mountain plover *Charadrius montanus*	1	Grasslands statewide
Long-billed curlew *Numenius americanus*	3C	Grasslands/wetlands
Black tern *Chlidonias niger*	2	Wetlands statewide
Loggerhead shrike *Lanius ludovicianus*	2	Woodlands/shrublands statewide
Fish		
Flannelmouth sucker *Catostomus latipinnis*	2	Green & Little Snake Rivers and tributaries
Roundtail chub *Gila robusta*	2	Green & Little Snake Rivers and drainages
Leatherside chub *Gila copei*	2	Slate Creek (Green Riv. drainage) Bear River, upper Snake River
Plants		
Opal phlox *Phlox opalensis*	2	Barren clay soils in near Opal

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*1 = Federal T/E listing appears appropriate and is anticipated. 2 = Current data insufficient to support listing. 3C = More widespread or abundant than previously believed, or no immediate threats identified.

Section 7(c) of ESA requires that Federal agencies proposing major construction actions complete a biological assessment to determine the effects of the proposed actions on listed and proposed species. If a biological assessment is not required (i.e., all other actions), the lead Federal agency is responsible for review of proposed activities to determine whether listed species will be affected. I would appreciate the opportunity to review your determination document.

For those actions where a biological assessment is necessary, it should be completed within 180 days of initiation, but can be extended by mutual agreement between the lead agency and the Fish and Wildlife Service (Service). If the assessment is not initiated within 90 days, the list of T/E species should be verified with me prior to initiation of the assessment. The biological assessment may be undertaken as part of your agency's compliance of Section 102 of the National Environmental Policy Act (NEPA), and incorporated into the NEPA documents. The Service recommends that biological assessments include:

1. a description of the project;
2. a description of the specific area potentially affected by the action;
3. the current status, habitat use, and behavior of T/E species in the project area;
4. discussion of the methods used to determine the information in item 3;
5. direct and indirect impacts of the project to T/E species;
6. an analysis of the effects of the action on listed and proposed species and their habitats including cumulative impacts from Federal, State, or private projects in the area;
7. coordination measures that will reduce/eliminate adverse impacts to T/E species;
8. the expected status of T/E species in the future (short and long term) during and after project completion;
9. determination of "is likely to adversely affect" or "is not likely to adversely affect" for listed species;
10. determination of "is likely to jeopardize" or "is not likely to jeopardize" for proposed species;
11. citation of literature and personal contacts used in assessment.

If it is determined that any agency program or project "is likely to adversely affect" any listed species, formal consultation should be initiated with this office. If it is concluded that the project "is not likely to adversely affect" listed species, I should be asked to review the assessment and concur with the determination of no adverse effect.

A Federal agency may designate a non-Federal representative to conduct informal consultation or prepare biological assessments. However, the ultimate responsibility for section 7 compliance remains with the Federal agency, and written notice should be provided to the Service upon such a designation. I recommend that Federal agencies provide their non-Federal representatives with proper guidance and oversight during preparation of biological assessments and evaluation of potential impacts to listed species.

Section 7(d) of ESA requires that the Federal agency and permit or license applicant shall not make any irreversible or irretrievable commitment of resources which would preclude the formulation of reasonable and prudent alternatives until consultation on listed species is completed.

If you have any questions please contact Steve Brockmann of my staff at the letterhead address or phone (307) 772-2374.

Sincerely,

Charles P. Davis
Field Supervisor
Wyoming State Office

cc: Director, WGFD, Cheyenne, WY
Nongame Coordinator, WGFD, Lander, WY
Area Manager, Kemmerer Resource Area, BLM, Kemmerer, WY

March 3, 1849

United States Department of the Interior
FISH AND WILDLIFE SERVICE
Ecological Services
4000 Morrie Avenue
Cheyenne, Wyoming 82001

TAKE PRIDE IN AMERICA

IN REPLY REFER TO:

ES/61411
spb W.02(blmoxrch2.spl)

August 19, 1994

Ms. Juli Elayne Crane
ECOTONE Environmental Consulting, Inc.
123 East 200 North
P.O. Box 3516
Logan, Utah 84321

Dear Ms. Crane:

Thank you for your letter of July 22, received by this office on July 26, regarding expansion of the Moxa Arch Natural Gas development. All species listed in our May 12 letter apply to the area of proposed expansion. In addition, the following species should also be considered: Whooping crane (Grus americanus) (endangered), which migrates through the area and may stop along the Green River, and the Category 2 candidate, Bastard draba milkvetch (Astragalus drabelliformis), found on rocky hills and ridges in the Green River Basin.

Much of the proposed expansion area is within Seedskadee National Wildlife Refuge, which is managed by the U.S. Fish and Wildlife Service. I recommend early coordination with the Refuge staff to avoid unnecessary delays and controversy if activities are planned on or near Refuge lands. Please contact Greg Siekaniec, Refuge Manager, at (307) 875-2187 to discuss issues specific to the refuge.

If you have further questions on this matter, please contact Steve Brockmann of my staff at the letterhead address, or phone (307)772-2374.

Sincerely,

Charles P. Davis
Field Supervisor
Wyoming State Office

cc: Director, WGFD, Cheyenne, WY
Project Manager, Seedskadee NWR, Green River, WY